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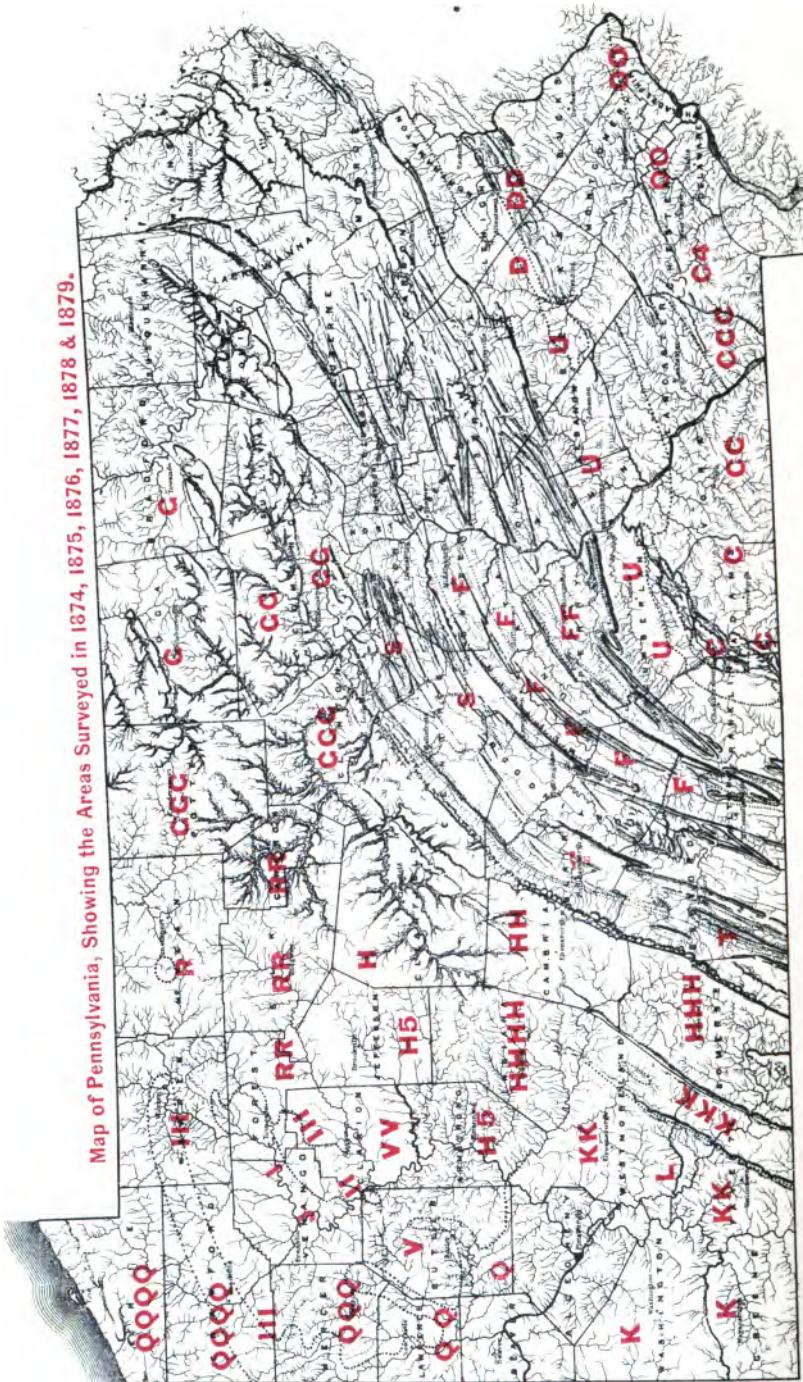








Map of Pennsylvania, Showing the Areas Surveyed in 1874, 1875, 1876, 1877, 1878 & 1879.



SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA:
REPORT OF PROGRESS IN 1876-9.

GGG.

THE GEOLOGY OF
POTTER COUNTY.

BY
ANDREW SHERWOOD.

REPORT ON THE COAL FIELDS

BY
FRANKLIN PLATT.

WITH A COLORED GEOLOGICAL MAP OF THE COUNTY,
AND TWO PAGE PLATES OF SECTIONS.

HARRISBURG:
PUBLISHED BY THE BOARD OF COMMISSIONERS
FOR THE SECOND GEOLOGICAL SURVEY.
1880.
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PHILADELPHIA, April 3, 1880.

To his Excellency the Governor, HENRY M. HOYT, *Chairman of the Board of Commissioners of the second Geological Survey of Pennsylvania:*

SIR: The survey of Potter county was made by Mr. Sherwood in 1876.

But from the wild nature of the region, this survey could be little more than a reconnaissance of the leading features of the country; a determination of its belts of low land and high land; or, what is the same thing, the geographical location of its belts of Coal measure, Conglomerate, Pocono, Catskill and Upper Chemung formations running in straight lines across it.

There are no useful minerals in the county, except at a few points where small areas of workable bituminous coal exist on the highest summits. These Mr. Sherwood was instructed to omit in his survey, because it was desirable that his undivided attention should be given to indications of the possible presence of the Mansfield ore beds, and to the study of the fossils.

In 1879 Mr. Franklin Platt was instructed to finish his survey of the lower coal beds along the whole extent of the Allegheny mountain from Maryland to the North Branch of the Susquehanna river, by going carefully over the coal areas of Potter county, and his report has now been added to Mr. Sherwood's report of 1876-7, and printed in this volume.

The colored geological map of Potter county accompanying the volume was prepared and printed on stone in 1877, and the edition sent to Harrisburg for use, where it has remained ever since awaiting the publication of the book.

(v GGG.)

It was prepared from Mr. Sherwood's manuscript copied township maps, geologically colored by himself on the ground.

The revision of the county by Mr. Platt, with a view to his report on its coal measures, revealed the fact that, while the map stands substantially good in the main, and will suffice as a guide to the geology of the county at large, there has been a notable mistake made in the coloring of the crests of the mountains.

In 1876 the special geology of the Conglomerate formation No. XII, in the northwestern counties, was very little known. Its division into Homewood sandstone, Connoquenessing sandstone and Sharon conglomerate west of the Allegheny river, or into Johnson run rock, Kenzua creek rock, and Olean conglomerate in McKean county, was not proven until 1879. Neither was the strong distinction drawn between the Olean conglomerate as the base of XII, and the Sub-Olean conglomerate as the top of X, suspected.

Consequently, Mr. Sherwood very naturally considered all the plateaus or mountain tops of Potter county when capped by Conglomerate rocks or massive sandstones as capped by Pottsville conglomerate No. XII, or as Mr. Ashburner would have said, Olean conglomerate.

In this he did but follow the reports of the First Geological survey.

Mr. Platt, however, in studying the patches of coal measures left in the Potter county troughs, discovered (as Mr. Carll and Mr. Ashburner had already discovered in their section from Roulet northward) that little or nothing of the true Conglomerate (*Olean*) No. XII, remains; and that the largest part of the summits and plateaus are capped by the *Sub-Olean*, or upper sandstone strata of the Pocono formation No. X.*

As the expense of reproducing the map would be great, and as no practical mischief will be done by the mistake, seeing that there are no valuable coal beds *in* formation XII in Potter county, the map is published as it stands; the

* See Mr. Ashburner's sketch report at the end of the volume.

reader being warned that the two colors, red and grey, standing for the Mauch Chunk red shale formation No. XI, and the Pottsville conglomerate No. XII, should be removed from it so far as relates to Allegheny, Eulalia and Keating townships, except around Coudersport and at one or two other points noted in Mr. Platt's part of the report.

It is probable also that far too much of the grey XII and red XI is represented along the whole line of the next basin, from Hector township in the northeast to Portage township in the southwest.

With this correction the map will stand ; but it must be kept in mind that even where the grey tint for XII is represented *it does not mean workable coal land* but merely the *Conglomerate capping of the high lands*. And it would be well for those who use this report, to color *in black* for themselves the few spots in the county where *workable* coal beds have escaped the general destruction. This they can do with very little trouble by consulting Mr. Platt's portion of the report.

His summary statement of the state of the case is as follows :

"The Pottsville conglomerate, No. XII, is in fact found in parts of Pike, Jackson and West Branch townships, (in the western continuation of the Gaines coal basin of Tioga county);—in a small area in the southeastern part of Sweden township ;—it occupies part of Eulalia township in the Coudersport basin ;—and it may possibly come into the highest hilltops in Abbott and in Sylvania townships, but only along the centre lines of the synclinals."

The surveys of Cameron and Clinton counties show that XI and XII pass over into Potter county along the whole south and southwest border.

Potter county presents a strong contrast to McKean county, which borders it on the west, in one respect, namely, that while its surface is in a wilder or less cultivated state its underground has not been much explored by well

sinkers. In McKean county on the contrary thousands of deep wells have made an admirable revelation of the underground geology.

Potter county contrasts in another way with Clinton and Cameron counties on the south, namely, in that these counties are deeply trenched by the water courses of the West Branch Susquehanna, the high steep outcrop walls of which afford the geologist every facility for studying the rocks beneath the coal to the depth of say 1500 feet.

The underground of Potter county therefore can be understood at present only (or chiefly) by examining the reports of McKean, Cameron and Clinton counties, now in press.

The possible existence of oil in the underground of Potter county is what most of its land owners will inquire for of the geologist. In the absence of oil wells the answer to this query must be drawn from our knowledge of the neighboring counties.

It is not impossible that an equivalent for the Bradford oil formation may exist under the northwestern parts of Potter county, at a depth of 2000 feet, more or less, beneath the highlands, and of 1000 to 1500 feet beneath the valley beds. The southeastern townships may also be underlaid with oil-bearing rocks of the same age, but they must lie much deeper, on account of the thickening of all the formations southeastwardly, across the basins.

A thorough *instrumental* survey of the county is needed to get accurate data respecting this important feature of its geology; but to this instrumental survey of the surface-rocks must be added experimental deep borings, before we can estimate precisely the *quantity of thickening* (southeastward) in the formations beneath the surface, and above the Bradford oil horizon deposits.

This thickening (southeastwardly) of all the deposits, along lines *crosswise* of the basins, is a universal phenomenon in northern and western Pennsylvania, as the First Survey of the State discovered, and the reports of the Second Survey confirm and illustrate. Its vast *economical* importance to the petroleum industry is exemplified in the report on McKean county.

It will suffice here to give three sections: 1. Mr. Chance's section at Lock Haven in Clinton county; 2. Mr. Chance's record of the well between Hyner and Renova in Clinton county; and 3. Mr. Ashburner's record of the Dennis well at Bradford in McKean county; and to compare them with (4.) Mr. Carll and Ashburner's general section at Roulet in Potter county.

The Lock Haven section is 18 miles southeast of Hyner.

Hyner (10 miles south of the Potter county line) is 45 miles south-southeast of Roulet.

Roulet is 32 miles southeast of Bradford.

1. At the gorge opposite Lockhaven the rocks below the Conglomerate measure according to Mr. Chance (Report F, Appendix B, page 265) thus:

| | | |
|------------------|-------|-------|
| XI. Mauch Chunk, | | 100' |
| X. Pocono, | | 1175' |
| IX. Catskill, | | 2106' |

From Conglomerate down to top of Chemung, 3381'

2. At the Hyner well, the rocks below the Conglomerate measure according to Mr. Chance (Proc. Amer. Philosoph. Soc. No. 101, Vol. XVII, p. 670, May 3, 1878) thus:

| | | |
|---|-------|-------|
| XI. Mauch Chunk, uncertain, partly concealed. | | |
| X. Pocono, | | 988' |
| IX. Catskill, | | 1016' |

From Conglomerate down to top of Chemung, 2002'+

3. At Roulet, the rocks beneath the Conglomerate (Olean) measure according to Messrs. Carll and Ashburner (Report GGG, Sec. No. 7, p. 104) thus:—

| | | |
|------------------|-------|------|
| XI. Mauch Chunk, | | 70' |
| X. Pocono, | | 880' |
| IX. Catskill, | | 370' |

From Conglomerate down to top of Chemung 770'

4. At Bradford, McKean co. the rocks below the Conglomerate (Olean) measure in the Dennis well as interpreted by Mr. Ashburner (Trans. Inst. Mining Eng. Vol. VII p. 319, and Proc. Am. Phil. Soc. Sep. 1878) thus:—

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| | |
|--|------------|
| XI. In the 115' interval from Olean Conglomerate down to the mouth of the well, | 10' to 15' |
| X. Pocono { above the well 100', } in the well 132', } | 232' |
| IX. Catskill, | 250' |
| From Conglomerate down to top of Chemung, | 497' |
| VIII. Chemung rocks to bottom of well, | 1837' |
| | — |
| The producing Bradford oil sand at the bottom of the well (+ 1') has a thickness of | 1834' |
| | 55' |
| From Conglomerate down to top of sand, | 1779' |
| From top of Chemung down to top of sand, | 1282' |

Now any intelligent person can see that if the *top of the Bradford sand* maintains its distance beneath the top of the Chemung formation at 1282' over the country to the southeast (in Potter, Cameron and Clinton counties) then its depth beneath the Conglomerate must *increase southward* thus:—

| 4. <i>Bradford.</i> | 8. <i>Roulet.</i> | 8. <i>Hyner's.</i> | 1. <i>Lockhaven.</i> |
|------------------------|----------------------|-----------------------|-------------------------|
| 497 | 770' | 2002' | 3881' |
| 1282' | 1282' | 1282' | 1282' |
| 1779' | 2052' | 3284' | 4663' |

As the Bradford *Dennis* well starts in the valley 115' below the Conglomerate, the well has to go down before striking the top of the oil sand only (1719'—55'=) . . 1654'

The *Dennis* well was stopped at 1978' (or 1983' by addition) not being productive. But a show of oil was reported in white sand at a depth of between 1688' and 1734'.

At Roulet the Allegheny river is about 500' beneath the Conglomerate on the mountain, and therefore a well would strike the Bradford horizon at (2052'—500±=) . . ±1552'

At Hyner's, the well mouth is 1206' beneath the Conglomerate, and the Bradford horizon ought to be at (3284'—1206'=) 2078'

At Lockhaven (Queen's run) the river bed is over a thousand feet beneath the Conglomerate, and a well to strike the Bradford horizon should have to go down (4663'—1000±=) ±3663'

This will serve to show how indispensable geology is to the oil-producer as a guide into new oil-land.

It will serve to show also that the Bradford horizon *underlies the surface of Potter county everywhere* (except perhaps in the northeast corner) even in the beds of the deepest of its valleys; and it only requires the accidental striking of one good oil well to organize a development of some special area of the county, which will have the effect of covering the whole region with experimental borings.

The extension of the Bradford development northeastward into New York State seems to have ceased; but its extension eastward into Potter county has been of late strongly indicated. Arrangements have been made to test the field in this direction in Potter county.

Far beneath the oil horizon of Bradford lie limestone formations under Potter county.

At Lock Haven and along the whole extent of the Susquehanna river valley the *Lewistown (or Lower Helderburg) limestone* No. VI presents its southern outcrop. Its northern outcrop ranges across the State of New York from east to west from Albany to the Falls of Niagara. The formation underlies all the northern counties of Pennsylvania and the southern counties of New York but has nowhere been reached by borings except possibly in the deepest of our wells, that of Mr. Watson near Titusville in Venango county, a record of which has never been given to the Survey. In this well the limestone (if struck) lies 4000'± beneath the Pottsville Conglomerate.

At Lock Haven Mr. Chance's section (above quoted) places the *Lewistown limestone* at 9145' beneath the Conglomerate, thus:

| | |
|-----------------------------------|-------|
| XII. Pottsville Conglomerate, | 129' |
| XI. Mauch Chunk red shale, | 100' |
| X. Pocono sandstone, | 1175' |
| IX. Catskill, | 2106' |
| VIII. Chemung, Portage, Hamilton, | 5764' |
| VII. Oriskany, wanting, | — |

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| | |
|--|-------|
| VI. Lewistown limestone, | 895' |
| V. Clinton shales, (holding fossil ore), | 1080' |
| IV. Medina and Oneida sandstones, | 2301 |
| III. Hudson river slates, | — |
| II. Trenton, calciferous, &c., limestones, | — |
| I. Potsdam sandstone, | — |

And it is therefore evident that it will never be possible, in Potter county, to reach either the iron ores of the Marcellus, the limestones of the Lower Helderburg, or the fossil ores of the Clinton, lying as they must do from 6000 to 7000 feet beneath the surface at Coudersport.

The *fish beds* and *shell beds*, holding workable iron ore at Mansfield and elsewhere in Tioga and Bradford county, come to the surface in Potter county, and deserve attention. No ore has yet been seen with them in Potter county; but the country is too little open to view (by cultivation) not to leave it a matter of expectation that some day or other one or more favorable localities will be discovered where the ore exists and will be at least as good as at Mansfield. That is not saying much, but it is still something—a little added to the economic geology of the county, singularly destitute as it is of mineral resources.*

The few localities where fish scales or bones were noticed by Mr. Sherwood, are mentioned in the text:—in Stewardson township (§ 30); in Wharton (§ 44); in Roulet (§ 99); and in Bingham (§ 224).

Remains of ancient (Devonian) fish have been found in beds at various horizons beneath the coal measures, not only in Bradford, Tioga, Potter, McKean, Warren, Venango, Crawford and Mercer counties, but along their southern outcrop in Lycoming county,—as far east as the Hudson river,—as far north as the Schoharie valley in New York,—and abundantly in the State of Ohio, where they have been obtained in great size and perfection, and admirably drawn and described in the reports of the State Geologist Professor Newberry.†

*At the same time the citizens of Potter county should beware of being deceived by some of the heavy red sandstones of IX, which look like iron ores and are not. (§ 151.)

† See an excellent sketch of the history of the study of Devonian fish, especially in Scotland, published in London Nature, No. 540, March, 1890, pages 428.

In Mr. Chance's Lockhaven section (F. 267, above cited) *a red conglomerate (No. IX) fish bed, 2 feet thick, full of iron concretions*, is placed 1844' beneath the Pottsville Conglomerate (XII), and 1537' above the assumed top of the Chemung (VIII.) This is equivalent to putting it 2818' above the calculated horizon of the Bradford oil at Lockhaven (Queens run).

In Messrs. Carll's and Ashburners section at Roulet (GGG, 105 above cited) *fish beds of IX* are mentioned (60' thick) at only 510' beneath the Pottsville (Olean) Conglomerate; and other *fish beds of VIII* are mentioned about 770' beneath the Pottsville conglomerate. The latter are no doubt those of the Wellsboro valley in Tioga and Bradford county; and the former are no doubt those outcropping in the Wellsboro' and Blossburg and Towanda mountain slopes, and also Mr. Chance's at Lockhaven. If so there is an increase of the rocks between them and the coal, from Roulet to Lockhaven, of 1537'-770'=667 feet. Every oil well must go through these *fish beds* to reach the Bradford *oil rocks*, and it is of the utmost importance that every well driller should be instructed to examine his pumpings carefully for whitish fragments of fish bones, scales or scutes, as they will do him (as well as the geologist) good service in calculation.

Other horizons of fish may be found, but these will still be useful.

The *plant beds* also should be kept in mind, like those of West Branch township (§ 74) and Roulet (§ 99), for they will supply additional horizons to measure from, especially in a country where spirit-levellings are continually interfered with by gentle dips, not possible to measure with accuracy, and often quite indistinguishable by eye or instrument, and yet of decided force in throwing the well sinker off his calculations.

J. P. LESLEY.



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GGG.
REPORT OF THE PROGRESS
OF THE
SECOND GEOLOGICAL SURVEY OF PENNSYLVANIA,
IN
POTTER COUNTY.

CHAPTER I.

General description of the county.

§ 1. Potter county occupies a position in the line of the upper tier of counties in Pennsylvania, exactly midway between the northeastern and northwestern corners of the State. In shape it is nearly square, having its southwestern corner cut off, abutting against Cameron county.

It is bordered on the north by the State of New York ; on the east by Tioga county ; on the south by Lycoming county ; and on the west by McKean county.

§ 2. *Its area* is stated in Gray & Walling's Atlas to be 1071 square miles, or 685,440 acres ; supporting a population, in 1860, of 11,470, and in 1870, 11,265—being a diminution, in ten years, of 205. Its county town is Coudersport.

§ 3. *Population.*—The area of Potter county is, therefore, very nearly the same as the area of Tioga county, (which is given at 1116 square miles, or 714,240 acres :—supporting a population of 31,044 in 1860, and, in 1870, 35,097—

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being an increase of 4053.) The population of Potter county is, therefore, only about one third that of Tioga county.

This striking difference is explained by the entirely different character of the two surfaces, their different elevations above sea level, and their different vegetation and agricultural capacities: all these characteristics being, of course, dependent upon the respective geological structure and condition of the two counties. The greater part of Tioga county is comparatively low, and the mountain belts are narrow, and widely separated: whereas, on the contrary, Potter county is traversed from side to side, in a northeast-southwest direction, by six ranges of highlands—broad, and not separated from each other by wide intervening valleys.

§ 4. *Levels above tide.*—Very few surveys have been made in Potter county, and what surveys have been made, have not been referred precisely to tide level. We are in possession of only one line of accurate leveling continuously carried across the county, namely,—that of the proposed *Jersey Shore, Pine Creek and Buffalo railroad* line. By means of this line, we learn that, starting from Williamsport (on the West Branch of Susquehanna river), at an elevation of 529 feet above tide [the putative level of the track of the Philadelphia and Erie railroad] and ascending the valley of Pine creek through Lycoming and Tioga counties, it enters Potter county at a point on its eastern border in Pike township, at an elevation of 1300 feet above ocean level. This point on the east line of the county is 75 miles from Williamsport. Pine creek has, therefore, fallen in that distance 770 feet (—about 13': 1 mile.)

From this point, ascending Pine creek waters to the center of the county, the proposed railroad line reaches its highest grade or Summit Tunnel, at 2229 feet above tide.

It follows down the waters of the Allegheny river to Coudersport, where the elevation is 1661; and still further down to Roulette, where it is 1537. It soon passes then over the McKean county line, and at Port Allegheny the grade stands at 1481 feet. It will be seen by this line that the lowest summit in the county between the waters of the

Susquehanna and the waters of the Allegheny is something over 2229 feet. Much of the high land of the county probably reaches elevations between 2500 and 3000 feet above tide.

Comparing this elevation with high points in other counties, we notice that the Keating Summit of the *Buffalo, New York and Philadelphia railroad*, between Emporium and Port Allegheny, in McKean county, is 1881 feet.

The well-known Dalson's Bench, on Howard Hill, in McKean county, reads: "2258 feet above tide," the top of the post on the highest point of Howard Hill being 2263 and the crossing of the Kane and Howard Hill road, on a line from Wilcox to Buttsville, 2192.

On the other hand, in Tioga county the highest elevation of grade on the *Williamsport and Elmira railroad* is at Granville Summit, just south of Troy. The railroad there stands at 1373 feet, while the mountain overlooking the railroad must be six or seven hundred feet higher. In this mountain the Blossburg coal basin lies, and the end of the *Corning, Blossburg and Tioga railroad*, at Fallbrook coal mines, has a grade level of 1842. The summit, before reaching the Antrim coal mines on the same mountain, near the end of the *Corning, Cowanesque and Antrim railroad*, stands at 1862 feet. The Blossburg mountain range, therefore, may be considered as having a general elevation of about 2000 feet above tide, and this elevation it probably carries through the southeastern corner of Potter county.

In like manner, on the Towanda mountain the highest elevation of the *Barclay and Schrader railroad* is at its Carbon run summit 2041 feet above tide; the head of the Barclay Plain near the coal mines being 1756.

It may be stated, then, in a general way, that the mountain district of northern Pennsylvania, through which descend the waters of the Loyalsock, the Lycoming, Pine creek, the Susquehanna (West Branch), Kettle creek, and the Sinnemahoning southwards, and the waters of the Genesee northwards, and the Allegheny river westwards—has a universal average elevation above the ocean of 2000 feet; but that in Potter county, where their headwaters meet in

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a very narrow compass, the general elevation rises to over 2500 feet—giving an exceptionally cold climate and an exceptionally solid forest surface, broken by deep gorges, and narrow, long, straight lowlands, which are themselves between 1500 and 2000 feet above the sea.

§ 5. *Jersey Shore, Pine Creek, and Buffalo railroad levels.*—The following table is to be found in Report of Progress N, page 148.

Jersey Shore, Pine Creek and Buffalo R. R.

| STATIONS. | Tide. Feet. | Ocean level. Feet. | Distance from Williamsport. Miles. |
|---|----------------|-----------------------|--|
| Williamsport, city limit. The canal level at Williamsport, however, is 518.9, according to tables 52, 114, 115, | 502 | 529 | 0 |
| Linden, (surface of canal,) | 501 | 523 | 2.77 |
| Larry's creek, (on plank road,) | 514 | 541 | 8.34 |
| Jersey Shore, (Main street) | 521 | 548 | 10 |
| Pine creek crossing, (Lentz,) | 532 | 559 | 16 |
| Pine creek crossing, (Ramsey's Bend,) | 558 | 585 | 19.58 |
| Waterville, (surface Little Pine creek,) | 587 | 614 | 22.71 |
| Jersey Mills, | 626 | 653 | 27 |
| Campbelltown, | 673 | 700 | 33 |
| Pine creek crossing, (near Slate run,) | 709 | 736 | 38 |
| Pine creek crossing, (near Cedar run,) | 760 | 787 | 43 |
| Babb's creek road, | 833 | 860 | 48 |
| Pine creek crossing, (above Marsh creek,) | 1106 | 1133 | 65 |
| Gaines' (water, Pine creek,) | 1232 | 1259 | 72 |
| Kibbourne's (water, Pine creek,) | 1274 | 1301 | 76.5 |
| Grade at summit of tunnel, | 2202 | 2229 | 92.5 |
| Coudersport, | 1684 | 1661 | 101 |
| Roulette, | 1510 | 1537 | 109.76 |
| Port Allegheny, (Table 184) | 1454 | 1481 | 117 |

* Levels on the J. S., P. Cr. and Buffalo R. R. were furnished by Mr. John S. Ross, Auditor. Datum: "Atlantic Ocean." This road is not yet built.

The levels on the Jersey Shore, Pine Creek and Buffalo R. R. have been made to correspond with the result of the late test level run over the Catawissa R. R., (by direction of Mr. W. Lorenz, chief engineer P. & R. R. R., Dec. 20, 1877.) Not having the exact proposed point of connection of the J. S., P. C. & B. R. R., with the Catawissa and Williamsport R. R., at Williamsport, but as the first point given in the table is Williamsport city limit, and, as seen in table 52, we will take the elevation as given at the terminus of the C. and W. Branch, 529.31, and will add 27 feet to each elevation in the first column for ocean level in the second column.

§ 6. *General character of the surface.*—To these unfavorable conditions must be added the general spread, over the

whole of Potter county, of the massive sandstones and gravel rocks immediately underlying the Coal measures. Inasmuch as the coal measures themselves have been very generally removed from the surface—only a few small patches of the lowest bed or beds being left—these flat sheets of massive sandrocks and gravel rocks occupy large areas covered with broken stone, and an unbroken forest, shading numerous swamps. The winter snows lie long and deep. The country is, therefore, little favorable for agriculture, but has been productive of great wealth in timber, and will in time be a fine grazing country.

§ 7. *Order of townships.*—Before entering upon a description of the detailed topography and geology of Potter county, the following schedule of its townships will be useful:

| Sharon. | Oswayo. | Genesee. | Brigham. | Harrison. |
|------------------|-----------|----------|------------|--------------|
| Pleasant Valley. | Clara. | Hebron. | Allegheny. | Ulysses. |
| Roulet. | Eulalia. | Sweden. | Jackson. | Pike. |
| Keating. | Homer. | Summit. | | West-branch. |
| Portage. | Sylvania. | | | Abbott. |
| | Wharton. | Oleona. | | Stewartson. |

§ 8. *Synclinal mountain ranges.*—It has been said that Potter county is traversed by seven ranges of mountainous belts separated by six belts of comparatively lower surface or very elevated anticlinal valley land. These synclinals* are named in succession from northwest to southeast† as follows:

7. The Ceres synclinal, on the northwest.
6. The Oswayo synclinal.
5. The Coudersport synclinal.
4. The Cowanesque synclinal.
3. The Mill Creek synclinal.
2. The Kettle Creek synclinal.
1. The Blossburg synclinal, on the southeast.

*This name "synclinal" is a geological term to express a long basin or trough, the rocks of which dip in from the sides toward the center line.

†The description of these synclinals further on in the report, follows the reverse order.

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All the mountain belts crossing Potter county lie in such synclinals, for in these troughs the higher rocks have been preserved when they have been eroded or worn away and carried off from the rest of the country. The synclinal mountains of Tioga county and Bradford county have been already described as consisting of elevated plateaus of Catskill, Pocono, Mauch Chunk and Carboniferous rocks: the Coal measures lying in patches along the summits, and the outcropping Catskill rocks forming the steep flanks on both sides.

§ 9. *Anticlinal valley ranges*.—It is evident that between any two synclinal ranges of mountain land there must necessarily be an intermediate lowland or valley, the rocks of which dip from a center line, in opposite directions, towards, into and under the two synclinal mountains.

Such a valley or lowland is called "anticlinal," and six such anticlinal valleys, or belts of lowland, traverse Potter county intermediate between, or alternating with, the synclinal mountain belts; and these are named in succession from northwest to southeast* as follows:

| | |
|---------------------------------|-------------|
| 6. Sharon | anticlinal. |
| 5. Roulette, Hebron and Bingham | anticlinal. |
| 4. Ulyses and Homer | anticlinal. |
| 3. Chatham-Farmingham | anticlinal. |
| 2. New Bergen | anticlinal. |
| 1. Stewardson | anticlinal. |

Of these, the first two pass across the county as open lowlands. The third is closed up by an amphitheater of mountains in Jackson township; the fourth is closed up in like manner southwestward in Keating township; the fifth in Roulette township; the sixth is broader than the rest and crosses the northwest corner of the county, making a rich agricultural region there.

§ 10. *Connection with Tioga county*.—The connection of these anticlinal lowlands or valleys eastward with the valleys of Tioga county will be evident from the maps accompanying this report: the first or Stewardson anticlinal and

* The description further on follows the reverse order.

the second or New Bergen uniting to form the Wellsborough valley ; the third or Chatham anticlinal opens broadly in Tioga county to the Tioga river at Lawrenceville ; the fourth and fifth make an open agricultural country in the northeastern corner of Potter county, drained by the head waters of the Cowanesque creek.

§ 11. *The axes on the map.*—This report being based, not upon an accurate topographical survey of the county, but upon a general reconnaissance continued through an entire season of field work,—it is impossible to locate, with anything like absolute precision, the axes or centre lines of either the synclinal or anticlinal belts above named. Lines, however, have been drawn across the map to mark approximately the deepest part of each synclinal, and the crest of each anticlinal ; and in describing their location in the county it must be done by such lines—the reader being referred to the well-known villages or other localities.

Difficulties of the survey.—The survey of such a county, broken up by ten thousand ravines and covered with rock and forest would, if carried out with instruments, be a most laborious and costly affair ; and probably no such survey will be accomplished for many years. Therefore whatever geological description is given here of any township or part of a township, must be understood to be but an approximation to the truth.

§ 12. *Dips.*—At the same time, the geology is extremely simple ; the dips are all very gentle ; the rocks lie, in fact, nearly horizontal ; and the anticlinal and synclinal waves into which this part of the crust of the earth has been folded, are long, straight and parallel to each other. All this is evident at a glance from the map.

§ 13. *The coloring of the map* will show how the anticlinal lowlands are composed chiefly of flat Catskill rocks. It will be seen—as, for example, along the run of the New Bergen anticlinal—how the streams, in crossing the axes, cut down through the Catskill and exhibit in their banks the Chemung rocks underlying the Catskill. It will be noticed that a broad belt of Chemung rocks is exposed along the Chatham anticlinal in Hector and Pike townships ; and

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a still broader exposure of Chemung rocks covers one half of Oswayo and nearly the whole of Sharon township.

§ 14. *Flat topped mountains.*—It will be also seen on the map that the mountain belts are formed chiefly of the Pocono sandstone overlying the Catskill, and that they are cut up into a multitude of irregularly shaped, flat-topped isolated mountains,—the streams between them flowing in Catskill rocks. It will also be seen that upon the upper surfaces of these Pocono patches lie thin plates of Mauch Chunk red shale, many of which are again, in turn, covered by smaller thin plates of Pottsville conglomerate. On a few of these last, lie still smaller patches of the lowest Coal measures ; and in two or three instances the lowest coal beds have been left in isolated knobs.

§ 15. *Coal measure patches.*—While the general geology of the county has been carefully blocked out, so that its citizens may no longer be in doubt as to the kind of formation at or around their properties, and in the neighboring hills, and sufficient indications are afforded to show where alone in the county the remaining patches of Coal measures can be found or need be sought for, there still remains a great deal to do in the way of careful instrumental surveying at those points where coal is likely to exist.

This much it is necessary to say and can be said with certainty :—that in no part of the county do any Coal measures exist except those of beds lying at the very bottom of the system : that in most cases where coal is found it will be only the lowest bed of all : and that where the hill or mountain may rise to an additional height of a hundred, or even a hundred and fifty feet, the patch of coal measures will not be likely to contain more than one good, reliable coal bed. This, however, will be of the greatest value to the future development of the material interests of the neighborhood, and may be the nucleus of a considerable trade.

CHAPTER II.

Synclinals and Anticlinals.

§ 16. *The Blossburg synclinal.*—Its axis just touches the southeastern corner of the county, crossing the valley of Young Woman's creek where this issues from the county, flowing south. Continued northeast through Brown township, Lycoming county, it runs to Antrim and Blossburg in Tioga county.

§ 17. *The Stewardson anticlinal* axis, coming from Wellsborough, enters Potter county at the northeast corner of Stewardson township, and leaves it at the northeast corner of Leidy township, in Clinton county.

The valley made by this anticlinal is about two miles wide, and runs directly through the center of Stewardson.

The surface is rolling and hilly.

Kettle creek flows along its northwest border. The head branches of Young Woman's creek all take their rise upon the line of the axis, and flow south into the Blossburg synclinal mountain.

§ 18. *The Kettle creek synclinal.*—This mass of highland commences in the northern part of Elk township, Tioga county, and occupies the southeastern half of Abbott; northwest half of Stewardson; southern half of Oleona; and the southeastern corner of Wharton townships.

Its axis crosses Little Kettle creek a mile and a half north of Kettle Creek Post-office, and runs thence to the southeast corner of Wharton in a direction about south 55 west.

The synclinal mass is about five miles wide, and possesses a pretty uniform height, cut in every direction—both cross-wise and lengthwise—by deep cañons like those of Hammersby run, Windfall run, Cross forks, and Kettle creek with its numerous branches.

Six complete thoroughfare trenches are thus excavated through the mass from side to side,—the headwaters of all

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these streams originating on the crest of the next anticlinal to the north.

Standing on the south brow of this range of high land, and looking southward across the Stewardson anticlinal toward the Blossburg range, the rolling surface of the low land spreads out at a depth of several hundred feet beneath the spectator.

§ 19. *The New Bergen anticlinal* is generated near Marshfield Post-office, Gaines township, Tioga county, where it brings up a patch of the Chemung. It runs thence, in a very straight line, through New Bergen to the southern corner of Wharton township, where the Sinnemahoning East branch leaves the county.

The valley made by this anticlinal is from three to four miles in width, and very straight.

Kettle creek and its branches head in this valley along the summit of the anticlinal, (where their banks offer exposures of Chemung rocks in a number of places, as exhibited on the map,) and then flow south into and through the Kettle Creek mountains.

The north fork of the Sinnemahoning flows along the northwestern edge of this anticlinal low country to the corner of the township.

§ 20. *The Mill creek-Pine creek synclinal*.—This range, in combination with the next or Cowanesque synclinal, forms the broadest belt of mountain land in the county,—occupying the central portion of it, from ten to twelve miles in breadth, and very elevated above ocean level.

The two synclinal mountain masses part company at the north branch of Pine creek, being thrown asunder by the rise of the Chatham-Farmingham anticlinal. Here the anticlinal valley commences which leaves the county in Hector township and broadens through Clymer, Chatham, Farmingham and Lawrencee, in Tioga.

The Mill creek-Pine creek range may be said to have its axial line enter the county near A. C. Crandall's, on Phœnix creek in Pike township, running thence to the southern corner of Portage township, where it enters Cameron county.

The general direction of the axis is about south 70° west.

Where the mountain mass, after crossing Pine creek, enters Tioga county, it is five or six miles wide, and here—north of Gaines' Post-office—is covered with important patches of coal measures.

Pine creek cuts down through this mass to a depth of a thousand feet below the upper surface.

§ 21. *The Chatham-Farmingham anticlinal axis* may be drawn, in a nearly straight line, from Sunderlandville in Hector township to the northwest corner of Wharton township, and thence across Cameron and Elk to the neighborhood of Caledonia Post-office: but, through nearly the whole of this distance, it is concealed in the double synclinal plateau last described.

It only rises to cause the erosion of the Catskill and the development of the Chemung formation as it is passing out of Jackson township across the northwest corner of Pike, to occupy the southeastern half of Hector. Bending then, to a course of about north 25° east, it passes through Mixtown to Lawrenceville in Tioga county.

The valley is about four miles wide on the county line.

The last patch of Chemung brought up on this anticlinal going west, is to be seen around the forks of Pine creek, to the north and west of West Pike post-office.

Everything to the west of this consists of the mountains of Pocono sandstone, capped with the Conglomerate and, perhaps—in spots—with lower Coal measures; while the multitude of branching ravines, distributed through the whole mass, have their high walls composed of outcropping Catskill red sandstones.

§ 22. *The Cowanesque synclinal* mountain forms the northern half of the broad central plateau.

Its axis may be said to enter the county exactly at the northeast corner of Hector township,—running thence to Gibson's forks in Hector township, and thence—in a nearly straight line—a little south of the southwest corner of Homer township; but, owing to the wild condition of the country and the extreme gentleness of the dips of the synclinal on both sides, it is impossible to locate its center line, except in the most general way.

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This is the mountain range which, in Tioga county, overlooks the Cowanesque creek from the north, and is the first which passes across the State line into New York.

§ 23. *The Ulysses and Homer anticlinal.*—This belt of lowland is about as wide, and nearly as long, as that of the New Bergen anticlinal ; running from the northeastern corner of the county to Forest House post-office in Keating township.

The valley which it makes may be said to head up in an amphitheater of high hills west of Homer. This heading up is caused, of course, by the sinking of the anticlinal, the flattening of its dips, and the spreading over it of the Pocono sandstone—the valleys of the Sinnemahoning cutting deeply, and exposing the red Catskill.

About two miles wide at its western end and increasing eastward to six, it broadens out over the whole extent of Harrison township and eastern Bingham, in the northeastern corner of the county.

Thus it may be said to be a valley 25 miles long, composed—as the map will show—entirely of a Catskill floor, none of the streams which traverse it cutting deeply enough to expose the Chemung rocks, until Louisville, or Ulysses post-office is reached :—after that, going north and northeast, the rise of the whole country thins the Catskill and allows the Chemung to appear, first in isolated valleys and finally over half the area of Harrison township.

In this absence of Chemung rocks in the ravines it forms a striking contrast to all the other low lands of the county ; and this, of itself, is evidence of its superior elevation above tide-water in comparison with the other lowlands

It is adapted throughout to agriculture—a fact attested by the greater number of inhabitants settled along it.

Many streams of considerable volume have their sources in this valley. These invariably flow through the center line both ways, towards the mountains and enter their walls through deep ravines.

In this valley rise the Sinnemahoning, the north branch of Pine creek and Allegheny river, the Genesee river, and the Cowanesque.

So far as the drainage of northern Pennsylvania is concerned, this belt is at the culminating point. There is one farm, bordering the Ulysses-Allegheny township line, in which springs exist from which run streams which are headwaters of the Susquehanna, the Allegheny, and the Genesee respectively ;—so that every rain-fall on this farm furnishes water—partly for the Atlantic through the Chesapeake ; partly for the Gulf of Mexico through the Mississippi ; and partly for the Gulf of St. Lawrence through Lake Ontario. The exact elevation of these springs is unknown, but thousands of other fountains, feeding these same rivers, lie necessarily at a much higher level. The fact is of no physical importance, but is a very popular curiosity.

§ 24. *The Coudersport synclinal mountain* is a prolongation of the unbroken highlands of McKean and Cameron counties northeastward,—in a direction north 50° east—for 20 miles through Keating, Eulalia and Lycoming townships and terminating in a few isolated knobs in southern Bingham township ; these knobs being cut off from the main body by the headwaters of the Genesee river.

The rest of the synclinal mass is deeply entrenched lengthwise by the Allegheny river, from Coalsburg to the south-east corner of Roulette.

Coudersport—the county town—lies in a deep trench (made by the river) ; and the highlands around Coudersport are capped with Coal measures.

All agricultural culture is confined to the immediate vicinity of the streams which penetrate the mass.

Near Coudersport its breadth is about five miles ; but in Keating township it combines with the two synclinals to the south of it in constituting the great uplands of Cameron.

The geological questions connected with this mountain will be treated in their proper places. The mountain is not so high, as the ranges further south (already described), neither are the ravines so deep ; and this is due, almost entirely, to the gradual thinning of the Catskill and Pocono formations towards the northwest.

In this gradual thinning, the Manch Chunk red shales (over the Pocono) and the Pottsville conglomerate over

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the red shales participate; and, therefore, not only are the mountains themselves not so high, but the plates of carboniferous capping them are not so prominent; and we have no certain evidence even that along the northwest edge of this synclinal the Mauch Chunk red shales exist. The outcropping of that formation, however, has been represented on the map, to give it the benefit of the doubt; and to show to the people of the county where approximately they should look for it.

§ 25. *The Roulette-Hebron-Bingham anticlinal valley* commences near the county line of McKean in an amphitheater of high land encircling the plain or valley of Roulette, and broken through by the Allegheny river in its way out of the county.

Thence it runs north 55° east for 25 miles, with a width of from two to three miles; its floor exhibiting, along the streams, exposures of Chemung rocks at intervals, but heavily covered in places with drift.

It has a considerable population, and its fields are well adapted for agriculture. It opens out between the ends of the mountain masses (synclinal) to the south and to the north of it, in Bingham township, and spreads round to join the anticlinal valley last described.

The drainage of this valley in its eastern half is altogether northward, by the Genesee, into Lake Ontario; in its middle course northwestward, by the Oswayo creek; and in its western half lengthwise, by Fishing creek into the Allegheny river.

In other words, we have now reached a part of the county on the great northern watershed, having fairly crossed the divide between the Susquehanna waters and the waters of the lakes and Mississippi river.

§ 26. *The Oswayo synclinal* mountain range is, in general structure and appearance, like the others previously described; but with its features moderated by the thinning of the formations of which it is composed; and, probably, by the entire erosion of the Mauch Chunk red shales, the Conglomerate above them, and the Coal measures *in toto*.

It was at first supposed that patches of the Conglomerate

lay upon many of the isolated portions into which this mountain mass—like all the rest—is cut up by the traversing streams; and that possibly even a small area of the lowest coal bed might be discovered here and there. But it is now almost certain that the whole of the Pottsville conglomerate formation, which once capped this range, has been swept away; and, consequently, none of the overlying coal measures can be expected to exist.*

The direction of the axis of the range is north 60° or 65° east, and the line may be drawn from a mile north of Williston post office, on Sartwell creek, in Pleasant Valley township, past Oswayo post office (half a mile to the south) to the Genesee river between Perryville and the Genesee Forks post office.

Isolated pieces of the mountain range rise between the branches of the Genesee to the east and west of Perryville; but the last trace of Pocono sandstone ends with some outcrops two miles and a half east of Perryville, in Birmingham township.

In Clara and Pleasant Valley townships it is from five to six miles wide, but narrows to four miles after crossing the south branch of the Oswayo, going east.

It is split through the center (like most of these synclinal mountain masses), by Oswayo creek, which flows nearly along the center of the trough, for four miles from Oswayo post office westward.

§ 27. *The Sharon anticlinal valley* occupies nearly all of Sharon township and the northern half of Oswayo.

It is more than five miles broad, and well suited for agriculture.

It heads up in McKean county westward, and broadens out into New York State.

It consists almost entirely of a rolling country of Chemung rocks—like that of southern New York and is crossed by Oswayo creek, and bordered:—on the northwest by Honeoye creek; and on the southeast by Eleven-mile run.

* See the notes of Mr. Ashburner and Mr. Carll appended to this volume.

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The axis of the anticlinal may be said to enter the north line of Oswayo township at its middle point, and to leave the county where Bell's run leaves it,—passing about half a mile to the northwest of Sharon Center.

§ 28. *The Ceres synclinal* mountain belt crosses the northwestern corner of Sharon township, and is only recognizable by hills containing red sandstones of the Catskill formation.

CHAPTER III.

GEOLOGICAL FIELD NOTES.

1. *Stewardson Township.*

§ 29. On Kettle creek, three quarters of a mile above the mouth of the Cross Forks, there is an exposure of Catskill thick-bedded red sandstone, suitable for building purposes, dipping northwest.

§ 30. *Fish scales* were seen in rocks a mile above this spot, at Anderson's saw mill. Here the same sandstones are well exposed, overlying red shales, with alternations of green shale, still dipping northwest; and in the shale are to be seen rhomboidal *scales of fish* an inch or more in diameter.

§ 31. About a mile and a half higher up the stream, where the road crosses it, the red and gray shales are well exposed—dipping more steeply to the northwest.

§ 32. In the northern part of the township, on Kettle creek, a mile below Oleona, red and gray sandstones appear, dipping northwest.

§ 33. These four observations are sufficient to show that the valley of Kettle creek, in this township, is excavated in the bottom measures of the Catskill formation; for, as far as we now know, the fish-beds lie within one or two hundred feet of the upper limit of the Chemung formation. The first three observations are in the open country of the Stewardson anticlinal; but for four miles below Oleona there are low mountains of Pocono sandstone, on the south side of the creek. It is therefore enclosed in the synclinal block. A branch of Kettle creek comes in at Oleona through a gate between two of these outside patches of Pocono sandstone, and its head springs are nearly on the anticlinal three miles east of Oleona.

§ 34. At the forks of the road, on top of a hill in the
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anticlinal plain, the stones and soil in general are red—evidently belonging to the Catskill formation.

§ 35. The *Catskill rocks* of the belt of the Stewardson anticlinal crossing the township from its northeast to its northwest corner at a distance of fifteen miles with a width of two miles—very regular—consist principally of such red shales and sandstones with beds of gray and bluish shales and sandstones. They contain no minerals.

§ 36. The *Chemung rocks* are nowhere noticed along the anticlinal—the streams nowhere cutting down deep enough to reach the bottom of the Catskill and to expose the top of the Chemung. On each side of the anticlinal valley runs a wall of Pocono mountain-side, with exposures of outcrops of thin-bedded gray sandstones. In the south wall may be noticed seven gates—six of which are the entrances to narrow and deep ravines; and *into* these gates flow all the waters of the south side of the anticlinal valley, forming the head-streams of Young Woman's creek.

In the north wall may be seen four such gates, *into* which flow northward small branches of Kettle creek. After Kettle creek issues from this north wall, the ravines are all in the opposite direction, letting out the waters from the north, southward, into Kettle creek, which leaves the township exactly at its southwest corner.

§ 37. The center line, or deepest line of the *Kettle creek synclinal*, may be drawn from a point midway of the northern township line to another point midway of the western township line. All the dips, therefore, observed along Kettle creek are necessarily toward the north; and all the dips of the northwestern corner of the township are towards the south. The dips on Young Woman's creek waters are all toward the southeast—becoming perfectly horizontal in the extreme southeast corner of the township.

§ 38. On top of the Pocono sandstone mountain patches lie plates of the *Pottsville Conglomerate*, which is, however, already become very thin. Its fragments make the table-lands between the streams broken and rugged. No Coal measures are known to cap any of these table-lands.

§ 39. The Mauch Chunk red shale was nowhere seen.

2. Oleona Township.

§ 40. This lies next west of Stewardson, bordering on Centre county. It is an unbroken wilderness; not a single family residing, in 1876, within its limits; and not a dug road crosses it in any direction. No exposures of rock were to be seen, and they must be very rare. The southern half is occupied by the Kettle creek synclinal mountain table-land,—crossed from north to south by the ravine of Hammersley run, which has its two little head branches on the New Bergen anticlinal in the center of the township, and enters the wall of Pocono sandstone flowing south. The bed of this cañon is undoubtedly red Catskill rock. Its walls, and the walls of the ravines which enter it, are of horizontal Pocono sandstone. Whether any Coal measures have been left on the mountain tops or not, is unknown.

The northern part of the township rises upon the next synclinal plateau to the north, and this is of the same character. Across the center of the township spreads the unbroken anticlinal belt of Catskill, and the streams probably cut down into and expose the upper measures of the Chemung. The east fork of the Sinnemahoning heads here, and makes cañons in the northern part of the township.

3. Wharton Township.

§ 41. This succeeds Oleona going west, and borders on Cameron county, and its northwestern line on McKean county. The unbroken anticlinal plain crosses it from side to side, being from three to four miles wide and consists of flat Catskill measures (with a red soil) gently dipping southeast and northwest from the central axis, which enters the township midway of its east line, and leaves it near its southern corner. The western heads of Kettle creek are on the anticlinal on the eastern side of the township, and flow south into and through the mountain mass which fills its southeast corner. Lasbaugh run heads further west, south

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of the axis, and flows into the mountain mass in Cameron county. All the rest of the township is drained southward by the east fork of the Sinnemahoning and its numerous branches: namely, Birch run in the north; Nelson run in the middle; and Bailey's run in the west. The village of Wharton Mills is upon Sinnemahoning creek, half a mile above the mouth of Bailey's run, and a mile below the mouth of Nelson run.

§ 42. Here, and all down the Sinnemahoning to the township line, the Catskill rocks seem to have been eroded through,—leaving the bed of the stream to consist of Chemung. Probably all the streams which head at the anticlinal axis—and especially Jordan run, which crosses it—expose a few of the uppermost layers of the Chemung. The ravines in the mountains to the northwest and to the southeast are, of course, in the Catskill red rocks. All the mountain walls which hem in these cañons and ravines, show nearly horizontal outcrops of Pocono sandstone. On the table-lands between them, at an elevation of many hundred feet, lie broad, broken uplands of Pottsville conglomerate and, no doubt, with some small remnants of Coal measures on the broadest of them. Their outlines are extremely irregular, and would require a world of study, to be pursued under the greater difficulties,—as the whole township (with the exception of isolated settlements along the Sinnemahoning) is a forest wilderness.

§ 43. On the Sinnemahoning, near Swartwood's house, on the road a mile and a half north of the county line, there is an interesting exposure of gray shales containing traces of *fossil shells*, and undoubtedly belonging to the *Chemung* formation.

§ 44. A quarter of a mile above this place—where a brook crosses the road—similar *Chemung fossils* were found in loose gray fragments, derived from some neighboring Chemung outcrop: and here, in one stone lying loose on the surface, was found a large *fish-bone*. In the narrows, a mile below Wharton Mills post-office, there is an exposure of soft gray shale in the road which must also be Chemung.

§ 45. At the forks of the creek, a mile above Wharton

Mills, the soil and stones about are red,—derived from the Catskill; and before reaching this point, the top of the Chemung has got below water-level.

§ 46. Red shale is again exposed along the road up the east fork, a quarter of a mile above the mouth of Nelson run; and continuing up the creek to the extreme northeast corner of the township, nothing but red Catskill débris and soil can be noticed. The creek has evidently cut back from the anticlinal northward and against the outcrop of the Pocono gray sandstone,—perpetually keeping under it as close as possible, and therefore always in the soft measures at the bottom of the Catskill formation.

§ 47. On the southern side of the anticlinal, Lasbaugh run has done precisely the same thing; flowing in the same direction for a distance of three and a half miles in the soft Catskill shales at the foot of the Pocono slope.

§ 48. *The Mill creek-Pine creek synclinal axis* may be drawn in a straight line from the northeast corner of the township to the Cameron county line one mile south of McKeon county corner.

§ 49. To the north of this line, and west of Nelson run, and north of the head waters of Bailey's run, spreads out an extensive *plateau of Pottsville conglomerate* which well deserves exploration;—as it may contain important portions of the lower Coal measures.

§ 50. As for the *Mauch Chunk red shale*, it is probably very thin, and so concealed by the overlying Conglomerate and by the dense vegetation as not to be observed.

§ 51. *Dip.*—The flatness—the almost perfect horizontality of the stratification, is well illustrated by the numerous sharp bends in the lower course of the Sinnemahoning creek; and by the general drainage of the southwest part of the township being in all directions;—to all points of the compass. These—in the absence of exposures—are perfectly good indications of horizontality; and they go to show that the New Bergen anticlinal is gradually lowering, or dying down, as it runs from Potter county into Cameron. In doing this, however, it carries:—first, the Chemung, and then the Catskill rocks, under; and allows the whole coun-

try to become a plateau of Pocono sandstone, Pottsville conglomerate and probably Coal measures,—as we see it further southwest on both sides of the great gorge of the Susquehanna.

4. Portage Township.

§ 52. This lies to the west of Wharton, along the Cameron and McKean county line. It is destitute of any anticlinal valley,—being capped by a plateau—or table-land—of Pocono sandstone, cut only by the Catskill rocks,—in the principal of which flow the various waters of Cowley run. These gorges are sinuous cañons between walls of five hundred feet in height; and the whole township is so wild, that only two families were known to be residing in it in 1876. The Chatham-Farmington anticlinal crosses the township in its southeast corner; and the Ulysses and Homer anticlinal in its northwest corner. The Cowanesque synclinal axis crosses its center south of Cowley run. It is impossible to say to what extent the lowest measures of the Coal formation have been preserved on the uplands.

5. Sylvania Township.

§ 53. This lies surrounded by Wharton, and next east of Portage, and is—like Portage—a wilderness of highland trenched by the gorges of the first fork of Sinnemahoning; constituting a water-tree with its stem at the middle of the south township line, and its branches extending into the three townships to the east, north and west—as the map will show. Isolated tables of Pocono sandstone are small, with the exception of the great plate in the southwest corner, and a large irregular plate east of North Wharton.

§ 54. *The Chatham-Farmington anticlinal axis* may be drawn in a straight line across the township from its exact northeastern to its exact southwestern corners. The Mill creek-Pine creek synclinal axis lies parallel to it within a mile and a half of the southeast corner;—and the Cowanesque synclinal axis within a mile and three quarters of the northwest corner. All the rocks of the township, therefore, may be considered as dipping very gently;—one half

of them from the center line northwest to the mouth of Freeman's run,—and the other half of them southeast. On this central anticlinal line, lie the two villages of North Wharton—at the forks of the Sinnemahoning ;—and East Homer, in the northeast corner. The whole valley of the Sinnemahoning is excavated in Catskill rocks.

§ 55. Gray sandstones, belonging to the Catskill formation probably,—and not to the Chemung—are exposed on the creek road, a quarter of a mile north of the township line : and again, near a saw-mill three quarters of a mile up toward North Wharton. The dip is here apparently southeast.

§ 56. *Catskill red rocks* outcrop near a school-house three quarters of a mile above the mill, and within a quarter of a mile of North Wharton. Here the dip is apparently to the northwest, which would shift the anticlinal axis a half a mile to the southeast of its theoretical position.

§ 57. A quarter of a mile above North Wharton, on the road side, may be seen half a dozen very large *boulders of Pottsville conglomerate*, which must have descended from the highland either in the neighborhood—by rolling down—or from more northern parts of Potter county, brought by glacial ice or otherwise. The latter supposition is made merely on account of the apparent accumulation of glacial moraine matter, all around Roulette (fifteen miles to the north.) No special observations were made upon glacial phenomena in this part of the county ; and this whole subject is involved at present in such obscurity, that it is not prudent to say much about it. It suffices that the uplands around North Wharton and on each side of the Sinnemahoning forks, are capped by Pottsville conglomerate, so that these blocks may have descended from any one of a hundred points in the numerous outcrops of that formation.

§ 58. Still ascending the Sinnemahoning a quarter of a mile further, genuine Catskill red shale soil makes its appearance in the road ; but on reaching a point within a mile and a half of East Homer, gray shale and sandstone are exposed ;—and these also no doubt are Catskill.

§ 59. The fact of the Sinnemahoning flowing in a narrow

gorge nearly along the axis of the Chatham-Farmington anticlinal—instead of in a broad, agricultural valley—shows how it has declined in relation to sea level, southwestward. The sinking disappearance of the anticlinals and synclinals southwestward under a broad spread of table-land—cut in all directions by ravines, and covered with forest—makes the tracing of their axes exceedingly difficult.

6. Abbott Township.

§ 60. This lies north of Stewardson, and against Tioga county. Its two villages are New Bergen—a mile and a half northwest of its central point;—and Germania—three miles west of its northeast corner.

§ 61. *The New Bergen anticlinal axis* runs—theoretically—through the village to a point on the western line, one mile north of the southwest corner. The whole drainage of the township is southward, by the waters of Kettle creek. Main creek heads at Germania, with branches to the east of it; flows south into the synclinal; and then along the center of the synclinal and so through southward,—receiving Long run in its way.

§ 62. *Little Kettle creek* crosses the township directly through its center, heading in the anticlinal and running south into and through the synclinal mass.

§ 63. *Cross Forks* gathers all the waters of the western part of the township:—namely, the waters of Lyman's run on the west; of the West Branch on the northwest; of Short run on the east; and Yocham run on the southeast; and the combined stream flows into the synclinal southward.

§ 64. The southeastern half of the township is, therefore, a mountain plateau,—subdivided into irregular tables of great height by a *multitude of ravines*, and covered with forest. The other half of the township is part of the broad belt of the New Bergen anticlinal Catskill valley, four miles broad; and along its center belt all the streams cut through the Catskill and expose the uppermost members of the Chemung.

§ 65. Starting from Germania along the road to New Bergen, Catskill red shale is seen exposed a mile and a half west of the village ;—and again, three quarters of a mile further on ; but where the road crosses Little Kettle creek, gray shales appear which are no doubt *Chemung*—although *no fossils* could be found to make it certain.

§ 66. Further on (where the old Coudersport and Jersey Shore turnpike first crosses Little Kettle creek below New Bergen), the red shales of the *Catskill* are exposed ; and a quarter of a mile further down, on the same road, an exposure of Catskill gray shales and sandstones is seen. Half a mile below this again, Catskill red shales are again exposed.

§ 67. Still descending the valley of Little Kettle creek, Catskill red sandstone is seen, dipping to the southeast a quarter of a mile from the last-mentioned locality towards Oleona.

§ 68. Three quarters of a mile further down the creek, gray sandstone appears ; and then red shale half a mile still further down, where the turnpike crosses a small branch.

At this point were noticed the first *boulders of Pottsville conglomerate*, which had rolled down from the outcrop on the brow of the highlands ;—and we may, therefore, draw in the northwest limit of the patches of conglomerate on the map opposite this point.

§ 69. Half a mile still further down Little Kettle creek, Catskill red shale and gray sandstone are seen exposed. This point is a mile north of the Stewardson township line.

§ 70. It may be said, then, that the lowlands of Abbott township are entirely composed of Catskill formation ;—and that the top of the *Chemung* is nowhere exposed except along the Cross Forks south of New Bergen, at the head branches of Little Kettle creek, (west of Germania,) and at the extreme head of Kettle creek at Germania. The lowland may be described as a belt of broken, low, hilly country ;—four miles wide by eleven or twelves miles long,—the hills rising several hundred feet above the waterbeds of the streams, and between very steep slopes.

7. *West Branch Township.*

§ 71. This township lies next north of Abbott, on the Tioga county line; and is traversed from southwest to northeast by the West Branch of Pine creek, flowing in a nearly straight course in a deep cañon, cut out of the Mill creek synclinal mass diagonally at an angle of about 15° to the line of the axis of the synclinal. It represents, therefore, a curious anomaly of the drainage flowing up hill;—unless, as is very probable, the axis of the synclinal itself declines in its course northeastward towards the county line. The affluents to the West Branch coming in from the northwest flow down the dip and across the axis of the synclinal. The New Bergen anticlinal crosses the southwest corner of the township, and the drainage from it is northward, to and into the synclinal mountain mass. This part of the township is occupied by Catskill rocks,—for example:

§ 72. *Catskill gray sandstone* outcrops near the bed of the stream, a quarter of a mile above A. B. Wharton's, on the west branch of Pine creek, near where it is crossed by the west line of Pike; and the dip here is northwest.

§ 73. At Wharton's may be seen a *block of Pottsville conglomerate* a yard thick and five or six yards long and broad, reposing on a steep slope by the roadside,—evidently having slid down from its outcrop on the top of the mountains to the north.

§ 74. *Plant bed.*—A half a mile above Wharton's house, gray and bluish shale and sandstones are exposed in the narrows. These also dip northwest, and contain traces of ferns and many plant stems. This plant bed locality is one of considerable interest, and should be carefully studied.

§ 75. *A hog-back ridge* runs two and a quarter miles directly east of Devens's hotel, on the old Coudersport and Jersey Shore turnpike, between the head of the Cross Forks and a branch of the West Branch of Pine creek. It is so narrow as to barely allow room for the road, with very steep slopes on each side down to the beds of the streams several hundred feet below.

§ 76. *Boulders of Pottsville conglomerate* occur on the

road leading from the West Branch to Coudersport; fill the bottom of the valley; and prove that the mountain tops on both sides of this gorge are made by thick plates of this formation.

§ 77. *Chemung rocks* appear only in the bottoms of the head-waters of the South branch of Pine creek, flowing north at the extreme limit of the township, where these head-waters cut the anticlinal; and also on the head-waters of Kettle creek and Little Kettle creek, where they originate in the anticlinal at the southern line of the township.

§ 78. *Catskill red rocks* occupied, therefore, one third of the township—most of it southeast of the mountain wall, which runs in a straight line from the northeast corner to the middle of the southern township line. The rest of the township is a mountain wilderness, cut up into isolated table-lands separated by deep cañons with steep, or even vertical, sidewalls—faced with outcrops of the Pocono sand-stone capped by conglomerate.

§ 79. *Coal measures* have been preserved from erosion on some of these table-lands; but the formation must be thin, and only the lowest bed or beds can be present, and these probably confined to the northern side of the West branch. The bottoms of the cañons are occupied by Catskill red, gray, and bluish shale and sandstone outcrops—the Pocono being largely made up of thin-bedded gray sandstone, interleaved with red shale.

§ 80. *Mauch Chunk red shales* (XI) have nowhere been seen, but no doubt exist.

§ 81. *The Pottsville conglomerate* (XII), forming the rim or brow of the mountain, is a hard, white quartzose sand-stone conglomerate, from 30 to 40 feet thick.

8. *Summit Township.*

§ 82. This township lies next west of West Branch, and cuts into Oleona on the south. It has a little of the Catskill anticlinal valley (exposed by the Homer and Ulysses anticlinal) in its northwest corner, at Ayer's Hill village, which stands on red soil at the foot of the northwest wall

of the great central mountain plateau; which occupies the whole of the township; deeply entrenched by ravines, in which flow the waters of the Sinnemahoning southward and westward; by the head-waters of the east fork of Sinnemahoning in the southeast corner of the township; and by the head-waters of Pine creek in the northeast corner. One continuous table-land of irregular shape runs across the southern part of the township from line to line: and on this belt of highest land remain some Coal measures.

§ 83. *Catskill* red and gray sandstones are exposed, with southeast dips, at a point about three fourths of a mile north from where the first fork of Sinnemahoning crosses the Sylvania township line, on the road to Ayer's Hill.

§ 84. The old *Coudersport and Jersey Shore turnpike* crosses the high mountain plateau of Pocono sandstone and Pottsville conglomerate—and probably patches of Coal measures—from where it leaves the head of Mill creek, south of Sweden valley, to where it crosses into West Branch township.

§ 85. *Catskill* rocks are only seen in the steep sides of the long, deep, winding gorges of the water-courses. They are seldom exposed, and can be examined with great difficulty, owing to the complete wilderness condition of the country.

§ 86. The run of the Cowanesque synclinal axis, on the northwest side of the Chatham-Farmington anticlinal axis, through the center, and of the Mill creek-Pine creek synclinal axis across the southeast corner, may be seen by reference to the map. It is in this township, and in its northern part, that a farm is said to lie from which the rain flows into Chesapeake bay, the Mississippi river, and Lake Ontario, as stated above.

9. Homer Township.

This lies to the west of Summit township, and is two thirds occupied by the same mountain mass along the Cowanesque synclinal,—cut through by the waters of the Sinnemahoning flowing southward and having their heads in the Catskill belt of the Ulysses and Homer anticlinal in the northern part of the township where the village of Homer

is situated ; but these head-waters do not cut deep enough to show any of the underlying Chemung rocks.

§ 88. *Catskill red rock* is seen in the road about a mile southwest of Homer post-office ; and again a half a mile further on.

§ 89. *Catskill red shale* is exposed in place in the road side half a mile north of Homer post-office ; and again Catskill red soil appears near the school-house half a mile further north.

§ 90. *Catskill rocks*, of course, form the lower part of the walls of the cañons in the high land.

10. Keating Township.

§ 91. This township lies west of Homer, on the McKean county line, and is all upland and forest country ;—through which flow the waters of the Allegheny northward and westward, and the waters of the Sinnemahoning southward and southwestward in deep gorges.

§ 92. *Forest House* is a village at the head of one of these gorges near the western boundary. The gorge of Portage creek flowing west lies below it to the north. Freeman's run—a branch of the Sinnemahoning—issues from an open lowland on the eastern side of the township, surrounded by an amphitheater of Pocono mountain walls, produced by the Ulysses and Homer anticlinal. Freeman's run then flows south into and through its cañons.

§ 93. *Pocono sandstone* (X) fills the road from Forest House to the Allegheny river with its characteristic gray soil and stones.

§ 94. *Dips.*—The drainage in all directions in this township proves the extreme flatness of the dips.

11. Roulette Township.

§ 95. This township lies north of Keating, on the McKean county line.

§ 96. *The Roulette, Hebron and Bingham anticlinal* crosses it from the northeast corner to the southwest corner—running through the village of Roulette in the center

of the township on the Allegheny river, where Fishing creek joins it, flowing from the northeast. Trout Brook from the northeast also enters the Allegheny river, a mile and a half above Roulette. Card creek, coming from the south, enters the Allegheny a mile below Roulette. Sart-well creek, flowing from the north, cuts across the northwest corner of the township. The Coudersport synclinal cuts across the southeast corner.

§ 97. Along the valley of Fishing creek, and along the valley of the Allegheny above Roulette, Chemung rocks appear at the surface,—brought up by the anticlinal; but there is some doubt on this head, as the whole surface seems covered with a wash of glacial moraine matter.

§ 98. *Catskill red rocks*, dipping southeast, are exposed in a railroad cut along the Allegheny river near the house of Mr. D. P. Reed,—in the southeast corner of the township.

Very red Catskill soil is also visible on the Allegheny river road, a quarter of a mile south of Trout brook.

§ 99. *Chemung gray shale* and sandstone are exposed in a railway cut a half a mile below the mouth of Fishing creek, on the south side of the river. The dip at this exposure is gentle—towards the northwest; *pebbles of quartz* are noticeable in some of the layers; and others contain *plant stems* and *shells*, and the remains of fish. The carboniferous stems of *reed-like plants*, in particular, are quite numerous.

§ 100. Fragments of what seemed to be Chemung rocks may be seen ascending Fishing creek a mile and a half from the river. The loose stones in the fields are gray, and apparently derived from Chemung beds.

§ 101. *Chemung conglomerate?*—Conglomerate is everywhere noticeable ascending the east fork of Fishing creek into Eulalia township,—not, however, in place, but strewn in masses over the surface of the bottoms. Such will be noticed as very abundant at the head of this stream in Hebron township. Mr. Sherwood is inclined to assign these masses to his *Chemung conglomerate*, near the top of that formation as quarried in Bradford county; but Mr. Ash-

burner and Mr. Carll think it more likely that they are transported blocks from a conglomerate of the Pocono sandstone,—forming the plateau to the north ;—and that, perhaps, they are connected with the movement of ice.

§ 102. A very red soil, in the road along the Allegheny river a mile and a quarter below the mouth of Fishing creek, and especially near the house of Mr. L. S. Marsh, shows that the river does not cut down into the *Chemung shales*, at all events after passing into the north dips of the anticlinal. In fact, red Catskill rocks were exposed in the river bank above the road at Mr. L. H. Babcock's, half a mile further down.

§ 103. Sartwell creek also shows, by its red soil and scattered stones, that it flows in a valley of Catskill.

§ 104. Three fourths of the county, therefore, may be considered as occupied by Catskill formation. The rest is mountain land capped by Pocono,—and which (so far as we can learn by the study of the geology of McKean county to the west) has none of the upper formations left upon it—neither the Conglomerate, nor the Mauch Chunk, nor Coal measures.

§ 105. On the southeastern side of the township, however, in the angle formed by the Allegheny river and Trout brook, there is probably a small Coal measure patch left on the highest ground. A little coal also may exist on the high land of the Allegheny, at the head of Card and Lanning creeks near the Keating line.

12. *Eulalia Township.*

§ 106. This township lies east of Roulette, and its southeastern corner is occupied by the open Catskill rolling valley of the Ulysses and Homer anticlinal. The northwest corner is occupied in a similar manner by a portion of the Catskill lowland produced by the Roulette anticlinal. All the rest of the township consists of a mountain mass through which the Coudersport synclinal runs, from a point half a mile west of the northeast corner, to a point a mile north of the southwest corner. Coudersport lies on the Allegheny river in the center of the township, and the an-

ticlinal axis appears to run within three quarters of a mile of it on the northwest side.

§ 107. *The Allegheny river* makes a deep and tortuous cañon across the whole township in the body of the synclinal,—entering the township with the synclinal axis at its northeast corner, and leaving the township south of the axis and exactly at its southwest corner. Mill creek enters the township from the east; has a forks at Lymansville; and joins the river at Coudersport. Dingman run enters the township on the north; makes a cañon through the mountain, flowing south; and enters the Allegheny river a mile below Coudersport. All these cañons are walled with Catskill rocks; and the isolated mountain plateaus between them are capped with Pocono, and, perhaps, with patches of the conglomerate.

§ 108. *Pocono gray sandstone* (X) with a slight northwest dip, is quarried at the lower end of the village of Coudersport, and yields some very good building stone.

§ 109. *Pocono gray sandstone* with a considerable dip to the northwest, is exposed in beds about three quarters of a mile south of Coudersport, on the road running over to Homer. A good quarry is indicated here.

§ 110. *Upper Pocono brown sandstone* may be seen on the top of the mountain near a school-house, a mile further along the road to the southeast; not in place; but loose fragments cover the surface. These fragments contain numerous plant remains, allied to the flora of the coal measures. Some of the species collected seemed to be different from any seen elsewhere. The locality is of interest to the fossil botanist.

§ 111. *Catskill red soil* makes its appearance half a mile or more further along the road to the southwest, descending the south side of the mountain.

§ 112. Catskill red shales are exposed in place on the Allegheny river road, about two miles and a half below—that is, southwest—of Coudersport.

§ 113. *Blocks of Pottsville conglomerate* are strewn over the surface, about a mile and a quarter still further down the river, on each side of the public road. Some of them

are of large size, and all of them have come down from the mountain tops to the north.

§ 114. At the forks of *Dingman's run*, a mile before it enters the Allegheny river—or a mile and a half due west of Coudersport—the valley is filled with the same kind of boulders, rolled down from the mountain tops on each side.

§ 115. *Ascending the Allegheny* from Coudersport eastward, past Lymansville to Colesburg, similar boulders of conglomerate occur between Coudersport and Lymansville; and again, a little out of Coudersport to the north, on the road to Colesburg.

At both these places are many *large boulders* and detached masses, derived from a bed of the same kind of rock existing near the top of the mountain. At the latter place especially, these boulders are of sufficient size, and in such quantity as to arrest the attention of every passenger.

§ 116. *Catskill* red and gray shales are exposed near the last named point, and not far from the north line of the borough of Coudersport, in the bank above the road. Red Catskill soil is also seen on the road leading north from Coudersport to Hebron, after passing Mr. N. Clark's house, about two miles and a quarter north of Coudersport.

§ 117. The *road to Colesburg* from the forks at N. Clark's passes over red Catskill soil with red and gray surface fragments; and where this road crosses the Hebron township line, the red shales are exposed in place.

§ 118. *Drainage inward*.—The topographical feature of most interest in the geology of northern Pennsylvania is exhibited in this township finely:—namely, the *drainage in opposite directions inward toward the anticlinal axis*. This involves the striking phenomenon—nowhere better exhibited than here—of the branches of a stream all heading in broad anticlinal valleys, and breaking into a central mountain mass through gates, and flowing through the center of that mass in a common stream.

§ 119. *Coal measure patches*.—It is upon the central summits of the synclinal that the highest measures have been left. The consequence of this is, that patches of Coal measures remain on the highest lands around Couders-

port.* One or two small coal beds have been opened on the mountain west of Dingman's run; but the mountains south of the Allegheny river, below Coudersport and Mill creek, have lost even the Conglomerate underneath the coal.

§ 120. *The Coudersport basin* is one of those oval dimples, or comparatively deeper places, in the otherwise continuous synclinal troughs or coal basins of northern and western Pennsylvania—a fine example of which (on a large scale), is furnished by the Saulsbury coal field of Somerset county, described in Mr. Platt's "Report of Progress for 1876, HII." In that volume will be seen an underground contour-line map of the Pittsburg coal bed,—showing the shape of the dimple, and explaining the unusual presence of the coal in that country. The Coudersport coal area is to be explained in the same manner. The Blossburg and Barclay coal fields, and the coal field of Sylvania township, are other instances. The rule, however, holds good for all the isolated basins of northern Pennsylvania. They represent the deeper portions of continuous troughs.

13. Sweden Township.

§ 121. This township occupies the exact center of the county, and is crossed by the broad open Catskill plain or valley of the Ulysses and Homer anticlinal—ranging almost exactly north 45° east, south 45° west. In the center of this valley, on the east branch of Mill creek, stands the village of Sweden. A mountain plateau occupies the northwest corner of the township; and a much more extensive mountain upland occupies the southeastern two fifths of the township lying in the Cowanesque synclinal; and through this latter mass the North Branch of Pine creek makes its break eastward—leaving the township at the center of its east line.

§ 122. *Catskill red soil* shows everywhere in the vicinity of Sweden Valley post office; and red shale is exposed in place at the northeast corner of the township, on the road between Mr. M. Snyder's and Mr. J. Snyder's houses. The

*See Mr. Platt's chapter of the Coudersport Coals, further on.

belt of Catskill thus indicated is from two to three miles wide.

§ 123. In the vicinity of Mr. W. J. Duel's, a great deal of *Pottsville conglomerate* may be seen in *fragments*.

§ 124. Catskill outcrops, of course, occupy all the gorges through the Pocono table-lands, on the highest summits of which—in the southeast corner of the township—patches of Coal measures holding the lowest coal bed may possibly be found remaining.

§ 125. There seems to be no coping of *Pottsville conglomerate* along the edges of the mountain plateaus. Whatever patches of conglomerate exist lie on the central summits.

14. Jackson Township.

§ 126. This township lies next east of Sweden, and is occupied by the Pocono upland, except in its northeastern corner, where an amphitheater of Pocono escarpment forms the southwestern head of the Catskill valley of the Chat-ham-Farmington anticlinal; and in the center of this amphitheater, the North branch of Pine creek has excavated (on the anticlinal) an area of Chemung rocks—which area passes over into the next township to the east.

§ 127. The *drainage* of the township is partly south into the South branch of Pine creek; the rest of it flows east, by the North branch of Pine creek. Whitmore run forms a number of ravines in the southeast corner. Cushing creek comes in from the north line, and enters the North branch of Pine creek.

§ 128. *The only locality* in all the township where rocks below the coal were seen exposed in place, was on *Cushing creek*—about half way between its junction with the North branch and Brookland. Here red Catskill rocks may be seen going under the bed of the creek, dipping northwest towards the Cowanesque synclinal. *Coal measures* are seen in place east of Whitmore run on the township line, and west of Whitmore run on the high ridge, between it and the next stream.

§ 129. *Whitmore run section, No. 1.*—Three miles above the *forks of Pine creek*, are two considerable streams com-

ing into the West Branch from the north—Whitmore run and—west of it—Beech Flat brook. Two or three miles up *Whitmore run*, on the west side of the right-hand draught or fork, Mr. Sherwood made the following section: Fig. 2.

Whitmore Run Section, No. 1.—Jackson township.

| | |
|---|----------|
| Top of the mountain. | |
| 1. Interval, concealed for | 20' 0" |
| 2. Coal, thickness unknown; smut, | 4' 0" |
| 3. Interval, concealed for | 39' 0" |
| 4. Coal, | 2' 0" |
| 5. Interval, concealed for | 36' 0" |
| 6. Coal, into which a drift has been carried fifty feet, . . . | 3' 4" |
| 7. Fireclay, | 2' 0" |
| 8. Interval concealed; probably brownish sandstone becoming gray and dark-colored towards the top, . . . | 89' 6" |
| 9. Pottsville conglomerate, No. XII; a coarse, hard, white and massive sandrock, containing pebbles, | 30' 0" |
| Total, | 175' 10" |

§ 130. *Coal bed*.—About three quarters of a mile from this spot, in an easterly direction, a large spring cuts through the coal bed, (No. 6 of the section,) making a fine natural exposure. The hill rises at this point above the coal 112 feet.

§ 131. *Pottsville conglomerate* (XII) crops out on the opposite side of the ridge, one or two miles from this spring in a westerly direction. Large masses of it have fallen from the parent ledge, and lie strewn over the surface below. Two of these many detached blocks are respectively 150 and 130 feet in circumference, and about 25 feet in height,—showing the thickness of the solid layer from which they have been derived. Small trees are growing upon them, and the whole scene is one of picturesque beauty.

§ 132. *Whitmore Run Section, No. 2*.—Another section was made on the east side of the right-hand draught of Whitmore run, opposite the place of the section given above. It reads as follows: Fig. 3.

Whitmore Run Section, No. 2.—Jackson township.

Top of the mountain.

| | | |
|------------------|---|---------|
| 1. | Interval, concealed for | 100' 0" |
| 2. | Coal, | 3' 0" |
| 3. | Fireclay, filled with roots, leaves of <i>neuropterus</i> , etc., | 2' 0" |
| 4. | Brownish sandstone; changing upwards to a gray, and dark slaty sandy rock towards the top, | 40' 0" |
| 5. | Pottsville conglomerate, No. XII, | 30' 0" |
| Total, | | 174' 0' |

§ 133. *Coal bed.*—Layer No. 2 of the above is the same as layer No. 6 in the first section, and its outcrop between the two localities runs entirely around the head of the right-hand draught of Whitmore run—a distance in the circle of about two miles and a half. This outcrop is everywhere marked by large springs of water,—some of which, at the fountain-head, are nearly large enough to turn a mill. They are determined by a bed of black clay slate forming the roof of the coal. The water falling on the broad levels above, percolates through the different beds until it reaches this impervious slate, and is then forced to seek an outlet at the surface.

§ 134. *The three-foot coal bed* in the two sections, seems to be the only coal of value here. It appears to underlie an area of several thousand acres. The coal, to all appearance, is good.

The same bed may be opened on the left-hand draught of Whitmore run, also at the head of Beech Flat brook.

§ 135. Two thirds of this township is an elevated wilderness, very nearly irreclaimable for farming purposes. Broken by ravines many hundreds of feet in depth, with vertical walls, and leading up to tables covered with broken rock of Pocono and Pottsville.

15. Pike Township.

§ 136. This township occupies the middle of the eastern tier of townships on the Tioga county line; and through it, Pine creek flows into that county near the southeastern corner of the township. Phoenix creek descends from the north along the eastern edge of the township, and unites with Pine creek in the neighboring county.

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§ 137. *Phœnix creek* thus cuts one of the great, deep trenches or cañons through the Mill creek-Pine creek synclinal mountain mass, which occupies two thirds of the township.

§ 138. *Genesee Forks* enters the township near its northwest corner; flows south across the Chatham-Farmington anticlinal, in an open country of Chemung rocks, with Catskill hills on the west, and joins the north branch of Pine creek at West Pike post office, on the borders of the Catskill belt. The combined streams, with a third branch from the north joining them within a half a mile, enter the mountain mass and cut a similar cañon through it, in a southeast direction, to Pike mills. Here the west branch comes up from the southwest through a similar deep gorge; and in a few hundred yards further, the south branch comes up from the south through another cañon. In the southwest corner of the township may be seen (on the map) the ravine of Beech Flat brook, descending southward into the west branch.

§ 139. A ravine a mile and a half long, descends upon the north branch from the northeast a mile below West Pike; and a mile still further down, a stream enters from the north,—the ravine of which completely isolates a patch of the mountain, east of West Pike, from the great central plateau.

Of course all these cañons and ravines are excavated in Catskill. The walls of Pocono, capped by Conglomerate, reach an elevation of nearly a thousand feet above the water-beds.

§ 140. *Catskill red shale* and sandstone give good northwest dipping exposures where the south branch comes into Pine creek at Sherman's grist mill, (Pike Mills post office.)

§ 141. *Catskill red soil* shows in the road; and the red rocks themselves show in the bed of Pine creek, a mile northwest of Kilbourn's hotel, (Pike Mills post office.)

§ 142. *Masses of Pottsville conglomerate*, fallen from the mountain tops, are seen filling the gorge, a quarter of a mile further up the north branch.

§ 143. *Chemung gray shaly* southeast dipping rocks

show in the west bank of the north branch, at a point where the stream is crossing the Jackson township line. Here may be studied 20 or 30 feet of strata;—so as to leave no room for doubt of the geological horizon.

§ 144. *Agricultural belt.*—This is the beginning of a belt of country, before mentioned, across which the Genesee Forks flows, and elevated by the *Chatham-Farmington anticlinal*, which crosses the northwest corner of the township. It is a belt of agricultural country covered with Chemung soil and fragments of Chemung sandstones. The belt widens at the northward—especially to the east of the Genesee Forks,—so that it attains a breadth along the Hector township line of at least three and a half miles; and when continued through Hector into Tioga county, makes the broad Chemung valley of Mixtown, Nelson and Lawrenceville, on Tioga river.

§ 145. *Blocks of Pottsville conglomerate* fallen from the mountain tops on each side are very numerous on the Catskill bottom and sides of the gorge of Phoenix creek.

§ 146. *The central part* of the township is an oval mass of Pocono sandstone mountain, with a straight northwest escarpment—part of the north wall of the Mill creek-Pine creek synclinal plateau; and this north wall may be drawn upon the map in a straight line from the northeast corner of the township through West Pike post office. The north face of the wall, and the belt of rolling country (a mile wide) at its foot, are all composed of Catskill rocks.

§ 147. *The Mill creek-Pine creek synclinal axis* may be hypothetically drawn from a point in the eastern line—half a mile north of its center—to the exact southwest corner of the township. The belt of land held in this synclinal is about six miles wide, and deeply gashed by ravines.

§ 148. It is not known whether any of the *coal measures* have been left on the central oval mass, between Phoenix creek and the west branch of Pine creek.

§ 149. *Coal beds*, however, have been preserved over a considerable area on the plateau southwest of the north branch; and the sections above given (§ 129, § 133,) will serve to illustrate it.

§ 150. *Coal south of the forks of Pine creek.*—There is, probably, but little, if any, coal left on the south side of Pine creek below the confluence of the north and west branches.

§ 151. *Iron ore.*—No iron ore beds have been seen; but some of the red beds of the Catskill formation have frequently been mistaken for practical iron ore beds by the inhabitants.

§ 152. *Drainage.*—The heading of Phoenix creek and Genesee forks in the Chemung anticlinal country at the north, and their parallel flowing southeastward down the dip into and through the synclinal mountain mass, is a repetition of the topographical phenomenon which rivets the attention of the geologist wherever he explores northern Pennsylvania. Pine creek collects its waters at Pike Mills, half way up the south rise of the synclinal; and, instead of continuing over the next anticlinal to the south, flows east and cuts round the eastern end of that (New Bergen) anticlinal, where it is dying down northeastward in Tioga county.

16. Hector Township.

§ 153. The *Chemung belt*, last described, passes across the southeastern half of the township; and through its center runs the axis of the Chatham-Farmington anticlinal, which crosses Phoenix creek a mile north of Sunderlinville.

§ 154. A *Catskill belt* runs along the northern edge of the Chemung belt; it is about a mile wide. Then rises the wall of the Pocono mountain plateau, against which heads Phoenix creek.

§ 155. *Genesee Forks* heads, however, at the north border of the township in the northwest corner, and cuts its cañon southward through the mountain mass of the Cowanesque synclinal. Its various branches and their ravines, split up the mountain into a hundred spurs, and isolate small masses of the most irregular form. The head-waters of the Cowanesque make other similar ravines in the northeast part of the township; and these waters all flow northeast into Tioga county.

§ 156. *Chemung conglomerate?*—*Boulders of gray sandstone*, which may be either Catskill or Chemung, are very numerous on the Genesee Forks, a quarter of a mile north of the Pike township line.

Other similar boulders were noticed where the road crosses the creek, near the house of Mr. B. F. Tubbs,—about a mile and three quarters northwest of Sunderlinville.

Others again, in still greater abundance, lie strewed between Mr. C. Brooks' and Mr. H. Rednor's houses, about four miles northeast of Sunderlinville. Here they occur in angular fragments resembling those found in Harrison township (next north of Hector.)

Whether the bed from which these sandstone blocks have come, has anything to do with the blocks of *conglomerate* seen 30 miles further west in Hebron township, is not proven; but it must occupy nearly the same horizon (near the top of the Chemung) as that described in Report G on Tioga and Bradford counties, pp. 56, 67, 90.

A belt of red Catskill land runs along the road between the Genesee Forks and Mr. B. F. Tubbs' house, northwest of Sunderlinville.

§ 157. *Catskill red soil* is seen in the northwest corner of the township, at several places near the forks of the road.

§ 158. *Pocono gray soil* and stones form the surface midway along the north line of the township, near Mr. Persing's house.

§ 159. *Coal* is said to exist on the mountain top, near Mr. R. W. Bailey's,—about four miles and a half northwest of Sunderlinville.

§ 160. *Catskill red rocks* occur in the extreme southeast corner of the township, at the foot and in the side of the Mill creek-Pine creek mountains.

All the narrow valleys and ravines, which break up the Cowanesque synclinal mountain belt, cut down into the Catskill formation. This belt is about three miles wide, and some of its isolated summits are capped with small patches of the Conglomerate; but no coal is known with any certainty to be left on its top.

17. Ulysses Township.

§ 161. This township lies next west of Hector, and is occupied, for more than one half of its area, by an open country of Catskill—four miles wide. The Pocono mountains occur only in the northwest and southeast corners of the township,—the northwest mass lying in the Coudersport synclinal; and the southeast mass in the Cowanesque synclinal.

§ 162. *The Ulysses and Homer anticlinal axis* may be drawn through the village of Ulysses, from a point in the north line a mile west of the northeast corner, to a point in the west line a mile and a half north of the southwest corner.

§ 163. *Drainage.*—All the waters of the township head along the anticlinal, and flow down the dip northward into the Genesee, and southeastward (through the Cowanesque synclinal) into Pine creek,—with the exception of one branch, which makes a thorough cut eastward into the Genesee forks. All the southern drainage collects at the village of Brookland, and flows through a cañon south into Jackson township.

§ 164. *Catskill* red and gray rocks, dipping southeast, are exposed in the quarry of Mr. H. H. Dent, at Brookland, where Cushing creek leaves the open country and enters the defile, a mile north of the township line.

Red shale is exposed also in the road about two miles northeast of Brookland, near Mr. F. W. Knox's house.

A gray band is exposed in the road, a little over a mile north of the last mentioned point, at Mr. G. W. Bennett's house. This exposure also dips southeast.

Red shale appears in place in the same road about three quarters of a mile further north; and the road soil, and the color of the fields in the vicinity of Ulysses village show that it is surrounded by Catskill rocks.

Catskill red shale appears again in the road about a mile and a half west of Ulysses, between the houses of Mr. W. Spicer and Mr. H. Stebbins. It shows again in the bed of

the valley half a mile still further west at Mr. J. Kimball's house, and at the forks of the road.

§ 165. From these and similar appearances, it is evident that the whole center of the township is occupied by the Catskill formation,—and that the anticlinal arch of the Homer-Ulysses axis—having a course almost exactly north 45° east, south 45° west,—is an exceedingly gentle uplift. The Cowanesque synclinal plateau east of Brookland is capped by Conglomerate, and may possibly support some remaining patches of the lowest coal.

§ 166. The fact that no large stream crosses the Ulysses-Homer anticlinal can alone account for the *non-appearance of Chemung rocks in this township*; for otherwise the erosion would have been deep enough, in spite of the extreme gentleness of the dips, to reach the top of the Chemung. The flatness of the anticlinal dips, also, has produced the unusual breadth of the low country.

§ 167. *Quaquaversal drainage.*—In this township happens again a curious phenomenon of the immediate proximity of the head fountains of three rivers, having their mouths in very distant localities: namely, the Allegheny, the Genesee, and the Susquehanna. In half an hour's walk, a man may drink from waters flowing to Lake Ontario; to Chesapeake bay; and to the Gulf of Mexico: and there is sufficient evidence of the general high elevation of the district.

18. *Allegheny Township.*

§ 168. This township lies next west of Ulysses, and is occupied, in its southeastern part, by a continuation of the broad Catskill valley (four miles wide) last described;—and in its northwest side by a similar Catskill valley two miles wide, through which runs the axis of the Roulette, Hebron and Bingham anticlinal,—bringing up Chemung rocks along the crown of the axis.

§ 169. *The drainage* of this township is in all directions,—the Genesee waters flowing north across the north line at various points;—and east across its east line past Raymond Corners. The southwestern half of the township,

however, is drained by the head branches of the Allegheny river, which unite at the village of Colesburg in the very center of the Coudersport synclinal mountain belt,—which occupies the middle of the township, varies in breadth from three to four miles, and is gorged in all directions, the bottom of the gorges being of Catskill, and the walls of Pocono: The river issues from the township at its southwest corner, exactly on the crown of the synclinal axis.

§ 170. Owing to the almost total *absence of rock exposures* in this and other townships, the color of the soil, the character of the loose stones on the surface, and the topographical relation between the highlands and the lowlands, are the only means possessed by the geologist for determining with any certainty the nature of the underlying rocks.

§ 171. *Catskill exposures.*—*Red shale*, however, appears in place in the road, a quarter of a mile north of Colesburg; and a quarter of a mile further, the red soil is apparent.

Red and gray rocks are again exposed in the road, one mile north of Colesburg.

Red soil covers the hill top about two miles and a half west of north Colesburg, between a school-house and a grave-yard.

Red soil appears in the road, about three quarters of a mile northeast of the school-house; and appears again in the roads a quarter of a mile south of the cemetery, between Mr. J. N. Weidman's and Mr. S. Chamberlain's.

Red shale appears in the road at the foot of the hill, a quarter of a mile further to the southwest, near Mr. N. Dwight's; and again, a quarter of a mile north of the cemetery; and again, a half a mile north of the cemetery; and again, (a mile further on,) near Mr. M. Higley's; and again, about a mile further north, near Mrs. M. Hutch's house; and again, about a mile south of Rose lake, or a quarter of a mile east of Mr. M. Wildman's; and again, near Mr. A. C. Scovell's, about three quarters of a mile south of Rose lake.

All these exposures are in the open Catskill country of

the Roulette, Hebron and Bingham anticlinal ; but the same sort of exposures are to be found when we pass to the south of the mountains—into the open valley of the Ulysses and Homer anticlinal, thus : *Red soil* shows in the road at Raymond Corners.

§ 172. *Conglomerate*.—But where the road from Raymond Corners from the northwest passes over the mountain, and at a distance of about two miles from the corners, in the neighborhood of W. Cobb's house, the surface is covered with *boulders* and masses of the *Pottsville conglomerate* ;—but without any indications of the presence of the lowest coal measures.

§ 173. *Chemung exposures* in this township are confined to a very narrow area in the valley-bed of the West Branch of the Genesee river, from the vicinity of Rose lake along the course of the anticlinal to the middle point of the north line of the township, and so into Genesee township. Of course it is only the top beds of the formation which are here exposed, and that not so that they can be well studied. These Chemung rocks consist of bluish shales and gray sandstones, with some conglomerate beds ; while the Catskill beds consist of red shale and red and gray sandstone ; and the Pocono rocks consist of thin-bedded gray sandstones ;—the Pottsville conglomerate—what there is left of it—on the highest summits being a white sandstone, interspersed with small pebbles.

§ 174. *Allegheny river head*.—As was mentioned in the description of the last township, one branch of the Allegheny river has its extreme head fountain just inside the Ulysses township line, and within half a mile of the springs which feed Pine creek (flowing into the Susquehanna) and the Genesee river (flowing into Lake Ontario.)

§ 175. *Rose Lake* has its bed excavated on the Roulette anticlinal, in Chemung rocks, a mile south of the northern line.

19. *Hebron Township.*

§ 176. This township lies next west of Allegheny, and is traversed through its center by the Catskill belt of low

country along the Roulette, Hebron, and Bingham anticlinal—with the Coudersport synclinal occupying its southwest corner, and the Oswayo synclinal mounts its northwest third—the anticlinal axis entering north of the middle point of its east line, and running out to its southwest corner.

§ 177. The village of *East Hebron*, on the south branch of the Oswayo, occupies a point, therefore, a little more than a mile down the northwest dip of the anticlinal; and the village of Hebron, another point about half a mile down the same northwest dip, on a branch of Fishing creek, which enters the Allegheny river at Roulette.

§ 178. *Drainage*.—The mountain masses are much broken up by the two thorough-cut *gorges of the Oswayo*; namely,—the South branch and Whitney's creek, both of them heading on the anticlinal and flowing out at the northwest corner of the township:—and also by numerous ravines of the West branch of Oswayo, and others descending northward into the East branch of the Oswayo along the northern line.

In like manner, the Coudersport mountain is separated into pieces by three thorough-cut gorges, through which Lent brook, Steer brook, and a third stream, (heading around Lamont, on the south slope of the anticlinal) flow southward into the Allegheny river.

§ 179. *Pottsville conglomerate* can hardly be expected to remain on the narrow summits between these waters and the river; but it is possible that a thin plate of the Pottsville may occupy more than one of the isolated plateaus in the northern half of the township. It is, however, possible that the highest rock on all the summits north and west of East Hebron is Pocono.

§ 180. *Exposures are very rare in this township.*

Red and gray rocks are seen on the road along Oswayo creek, between Mr. J. M. Hyde's house and the Clara township line.

Red soil shows in the road up the South Branch of the Oswayo, two and a quarter miles from the forks towards East Hebron.

Chemung gray soil and stones, however, are evident in the bed of the south branch of the Oswayo at East Hebron ; and all the beds of the creek and its branches southeast of East Hebron, along side of and crossing the anticlinal, are probably excavated in the upper layers of the Chemung formation. The same may be said of the bed at the head of Whitney's creek, and of the bed of Licking creek for a mile above Hebron, and from Hebron down to the township line.

§ 181. *Chemung conglomerate?*—Near the saw mill about one mile southeast of East Hebron, and about 40 feet above the bed of the creek, there are large detached masses of coarse conglomerate—such as were described in treating of Roulette township in a previous part of this report ; and the same doubt hangs over the mother bed of these masses. Mr. Sherwood considers it probable that they are derived from a layer at the top of the Chemung similar to that described in his report of Bradford county ; but Mr. Carll and Mr. Ashburner feel sure that they have been brought down from conglomerate layers belonging to the bottom of the Pottsville or top of the Pocono formation—such as they have observed near the tops of the mountain, and call in McKean county *Olean* and *Sub-olean conglomerate*.*

Whether or not these head-waters really cut down into the Chemung, it is evident that Catskill lower beds soon lap over them on the slightly higher ground where the soil is *characteristically red*.

Such is the case on the hill about three quarters of a mile west of Lamont ; and again, on top of the hill west of Mr. D. Clark's house, a mile and a half southeast of Hebron, where the soil in the fields and in the roads is quite red.

The same *red soil* may be observed in the road near the house of Mr. C. Stearne, three quarters of a mile southeast of Hebron.

The *conglomerate boulders* above mentioned cover the surface at the forks of the road, a quarter of a mile southeast of Hebron ; and large regular blocks of the same coarse

*See Appendix to this volume.

conglomerate are seen at Hebron, and thence all the way down Fishing creek into Clara and Roulette townships. With this exception all the Catskill rocks wear the same aspect as in other parts of Potter county.

20. Clara Township.

§ 182. This township lies to the west of Hebron, and continues its geology without change in that direction—nearly the whole township being occupied now by the Oswayo synclinal mountain mass—here widened to nearly six miles, and drained through profound cañons (northward) past Clara village into the Oswayo creek, and (southwestward) into Fishing creek;—the irregular central mountain top meandering unbroken across the township with isolated mountain summits cut off from it by thorough-cut ravines, and none of them certainly covered with any rocks higher than the upper layers of the Pocono.

§ 183. *Catskill red shale* is seen in the road half a mile south of Clara post office (kept by Mr. J. L. Allen.) Red soil appears a mile and a quarter southwest of the post office, on the main branch of the Oswayo, near Mr. Wm. A. Cole's house. Green Pocono sandstone soil and stones form the road-bed crossing the mountain southwards to the left-hand branch of Fishing creek; but the topmost parts of the mountains are capped with a conglomerate which Mr. Sherwood has supposed to be Pottsville,—but which the study of McKean county shows to be more probably the *Olean conglomerate*—so extensively developed in McKean county—or perhaps the *Sub-olean*.

§ 184. *Catskill red soil* reappears to the traveler immediately on beginning the descent into the valley of the North Fork of Fishing creek, and continues along the road all the way down that stream to the southern or Roulette township line.

§ 185. *Chemung Conglomerate?*—The conglomerate boulders already alluded to are abundant in the valley of Fishing creek, in the southeast corner of Clara township; and are very coarse and massive and may very well be taken

for bowlders of the Pottsville conglomerate by one who is familiar with that formation in Lycoming, Bradford and Tioga counties.

§ 186. *Exposures are very rare* in Clara township and the geology is, therefore, on a reconnaissance survey, very general and indefinite,—the important point being that the tops of the mountain-ranges cannot be expected to hold any coal; and that the erosion of the Catskill down to, or close to, the top layers of the Chemung has taken place only in the valley of Fishing creek, in the extreme southeast corner; and in the valley of the Oswayo, along the extreme northern edge of the township.

§ 187. *Abnormal drainage*.—It is a very remarkable fact, and one which violates the usual topographical law of the northern counties, that all the water courses of Clara township flow more or less diagonally from the central synclinal towards the bounding anticlinals,—that is, not down, but up the dip of the rock.

21. Pleasant Valley Township.

§ 188. This lies west of Clara, bordering on McKean county, and resembles Clara township, last described—being equally mountainous and wild, without a single village in its limits. Two thirds of it consists of a mountain plateau with a northern wall of Catskill; a belt of Catskill about a mile wide, running east and west lies next north; and Chemung rocks come up on the borders of Sharon township to the north. The mountain has an almost unbroken wall, running east and west, from which descend short ravines made by the head-waters of Bett's run—flowing north into Sharon township. The mountain itself is drained southward by the straight ravine of Sartwell creek, which makes a tree of ravines by its numerous short east and west branch runs. Williston post-office is on Sartwell creek, at the mouth of Bear creek (one of these runs), a mile north of the southern township line. The heads of the ravines leading into Fishing creek, eastward, cut the eastern border of the township. Between these head-waters and the eastern runs of Sartwell creek, spreads an irregular

north and south plateau of Pocono rocks,—probably covered with no higher formation, and probably faced above with the *Olean conglomerate* of McKean county

§ 189. *Red soil* is seen in the fields and roads everywhere along Sartwell creek, and in its side ravines.

§ 190. *Pocono Sandstone*.—Most of the exposures of rock in the township—and they are very few in number,—are of the outcropping Pocono sandstones in the steep side walls, and at the summits of the mountain gorges. Bowlders and masses of a *conglomerate* (probably the *Olean*) have fallen, and lie along the road up Sartwell creek

§ 191. *Chemung*.—The narrow strip of Chemung which lines the northern edge of the township, is the southern limit of a wide expanse of open country—made of that formation occupying most of Sharon township to the north. The Oswayo synclinal axis cuts diagonally across the township,—crossing Sartwell creek about half a mile above Williston ;—but no anticlinal axis touches the township. This is no doubt due to the extreme flatness of all the measures,—producing an unusual width of the Oswayo synclinal basin.

22. *Sharon Township*.

§ 192. This township occupies the northwest corner of the county, and is almost wholly occupied by the Chemung formation—brought up by the exceedingly flat Sharon anticlinal, which crosses the township diagonally in a course about north 30° east, south 30° west,—passing Oswayo creek about a mile below Sharon Center.

§ 193. *Catskill patches*.—In the extreme southeast corner rise two patches of Catskill hills. very small ;—one, half a mile south of Millport : and the other, between the Oswayo and Eleven-mile run.

Three larger patches of Catskill rocks occupy the northwestern corner :—on each side of Horse run—to the north of Honeoye creek—and to the west of Shingle-house—running over into McKean county. The two others pass over into the State of New York.

§ 194. The Ceres anticlinal cuts across the extreme corner of the township, north of Horse run.

§ 195. *The Chemung belt* occupying the center of the county is about five miles wide—Eleven-mile run bordering it on the south, and Honeoye creek on the north. Butler creek joins the Honeoye at Goldsmith Corners, within half a mile of the New York line. A mile down Honeoye creek lies the village of East Sharon. At the junction of Honeoye creek with the Oswayo, lies the village of Shingle-house. Sharon Center is on the Oswayo, three miles above Shingle-house; and Millport, on the Oswayo, is a mile and a half above Sharon Center. This unusual number of villages in the township shows the agricultural qualities of the Chemung plain. The Catskill surface is also susceptible of cultivation, so that the whole township may be considered as fit for agriculture.

§ 196. *Dips*.—The extreme flatness of all the rocks is shown by the fact that the Oswayo creek—entering the township at its southeastern corner,—pursues a perfectly straight course northwestward to the McKean county line—without paying the slightest attention to the Sharon anticlinal, which it crosses; but, at the same time, the positive character of the southeast and northeast dips is exhibited in the topography by the direction of the subordinate streams.

§ 197. *Chemung conglomerate boulders?*—About three fourths of a mile northeast of Sharon Center, the fields are strown with large, detached *masses* of white sandstone conglomerate—the exact horizon of which was not ascertained. If the mother rock be in the neighborhood, it must belong to the Chemung formation, in a position from one to two hundred feet below its top limit. The presence of this conglomerate can hardly be accounted for on the hypothesis that they are parts of a *glacial moraine* coming from the north or northeast and bringing Olean conglomerate fragments—because no highlands covered with Pocono exist in that direction. It would be necessary, therefore, to suppose them brought from the tops of the mountains of the townships lying to the south; and if they were brought by ice, it must have been through the agency of a

secondary glacier descending the Oswayo creek from Hebron township. The presence of these blocks lends, therefore, a show of probability to Mr. Sherwood's supposition that his Chemung conglomerate of Bradford county really exists in Potter county.

The same *conglomerate boulders*, mixed with loose gray stones belonging to the Chemung, are strown over the surface everywhere between Sharon Center and East Sharon; —that is over the central district of the township

The presence of these sandrocks has undoubtedly caused the inhabitants to entertain the mistaken idea that coal exists in the neighborhood;—because these conglomerate blocks have been naturally referred by them to the Pottsville conglomerate, which in the coal regions immediately underlies, and sometimes overlies, coal beds.

Mr. Sherwood reports that he has seen the same kind of rock on the Genesee river, between the State line and Wellsville, (in the State of New York,) and exactly on the prolongation of this same Sharon anticlinal.

§ 198. *Chemung gray sandstones* are exposed in place about a mile southeast of East Sharon; but on the other side of the Honeoye creek—a mile and a half northwest of East Sharon,—the roads and fields are colored red from the disintegration of Catskill rocks.

§ 199. Thin-bedded gray sandstones—diagonally laminated and containing a few *fossils*, and occasionally small *pebbles* of quartz,—are to be seen a mile and a half northeast of Shingle-house, at a place north of James Sherwood's house, on the northern side of the Honeoye creek, and near the top of the hill. These are probably some of the transition layers between the Catskill and Chemung.

§ 200. *Chemung soil* and stones characterize the soil between Shingle-house and Millport, along the Oswayo creek road. Other exposures in the township are very rare. The Chemung rocks—as far as they are seen—consist of gray shale and sandstone, with one or more beds of white conglomeratic sandstone; while the Catskill rocks consist mainly of soft red shales. There is very little doubt that Honeoye creek and Eleven-mile run have cut their channels

as nearly as possible in the junction layers of the Chemung and Catskill.

23. Oswayo Township.

§ 201. This township lies next east of Sharon, and against the New York State line.

Its northern half is occupied by the same broad agricultural Chemung country, lifted by the Sharon anticlinal.

Eleven-mile run, heading in the northeast corner of the township, runs in a straight line diagonally through its center, along the junction of the Chemung and Catskill as in Sharon township,—receiving its branch-runs wholly from the northern side, that is, down the dip. It does not seem to have a single branch coming from the south; and, consequently, the belt of Catskill red shale—about a mile wide—which borders it on the south, is drained also down the dip southward against, and into, the Pocono highland which occupies the south and southeastern part of the township. The affluents of the north branch of the Oswayo creek are concentrated at the *village of Oswayo*, within half a mile of the southern township line.

From this point, in all directions, radiate a *multitude of ravines*—the beds of which consist of Catskill red shale; and the steep slopes of which consist of the Pocono formation, which is here (on its extreme northwest outcrop) comparatively very thin, and certainly supports none of the higher formations. Its upper surface is still probably composed of the hard rocks belonging to the Olean conglomerate group of McKean county.

§ 202. *The Oswayo synclinal axis* may be drawn from the center of the south township line, opposite Oswayo, in a direction about north 30° east into Genesee township.

§ 203. *Red soil* makes the road in the southeast corner of the township, between Mr. C. Head's and Mr. R. H. Smith's houses.

§ 204. *Conglomerate boulders* are strewn over the fields a mile east of Oswayo post office, having rolled apparently from the hills above. This proves the presence of the *Olean conglomerate group* on top of the mountain, and

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makes it probable that the conglomerate bowlders (just mentioned in the description of Sharon township) have had the same origin. Certainly these bowlders can not be of the millstone grit or *Pottsville conglomerate* connected with the coal measures.

§ 205. Red and grayish rocks belonging to the Chemung are exposed in the road, about half a mile below Oswayo creek, near the township line.

§ 206. *Catskill red shale* is exposed in the road about two miles northeast of Oswayo.

Red shale and gray sandstone may be seen along the same road, at several points a mile and a half further on, where the road passes over a hill.

§ 207. *Dip*.—In the extreme southeast corner of the township, the dip may be observed to be northwest; that is, toward the Oswayo synclinal axis.

24. *Genesee Township.*

§ 208. This township lies next east of Oswayo, and also against the New York State line, and has but a narrow strip of the Chemung country stretching along the same, which is about a mile and a quarter wide at the west—tapering to a point at the northeast corner of the township.

§ 209. The *Catskill belt*, about a mile wide, continues to border it on the south; and Genesee Forks village stands on the junction of the two formations.

§ 210. *Pocono plateau*.—South of the Catskill belt there spreads over one third of the township (west of the west branch of Genesee) a plateau of Pocono highland, cut by ravines. A long, irregular, narrow patch of Pocono highland stretches north and south from Genesee forks to Ellisburg, between the west and middle branches of the Genesee: and points of the Pocono highland of Bingham township penetrate Genesee township across its eastern border, on both sides of the Genesee river. One small patch of Pocono occupies also the southeastern corner.

§ 211. Between these *isolated tablets of Pocono* spread tortuous half-mile-wide valleys of Catskill; and the Che-

mung top rocks make their appearance south of Ellisburg, on both the head branches of the west branch; and also east of Ellisburg, at the head of the middle branch—where these waters are cut by the Roulette, Hebron and Bingham anticlinal.

§ 212. *The drainage* of the whole township—excepting at its extreme southwestern border,—is eastward and northward to the forks of the Genesee and so into the State of New York—as the map will show. The extreme flatness of all the measures is shown by the disregard which the erosion seems to exhibit, of the presence of the anticlinal and synclinal axes—the Oswayo synclinal crossing the township diagonally about north 25° east, south 25° west, from a little above Perryville, which is a mile above Genesee Forks.

§ 213. *Red shale* exists on the hill half a mile south of Ellisburg, between the forks of the west branch. The exposure shows a northwest dip.

§ 214. *Chemung gray* rocks are seen in the beds of the streams east and west of Ellisburg, at the forks of the west branch.

§ 215. Going north from *Ellisburg* down the west branch, red rocks occur at the distance of about a mile—still with a northwest dip toward the synclinal; and about two miles from Ellisburg, in the road along the west bank of the west branch, a good deal of reddish sandstone is seen bedded nearly horizontal, showing the close proximity of the Oswayo synclinal.

§ 216. Passing the synclinal and still descending the west branch to a point a mile above its mouth, a southeast dip in the rocks occurs, composed of gray shale and sandstone on the west side of the stream in the road. No fossils were here observed, and the rocks are no doubt Catskill.

§ 217. On the opposite side of the creek—half a mile southeast of this point—the road shows a good deal of red soil.

§ 218. Red soil and stones are in the road following the west branch half a mile south of the Genesee Forks post-office; and red soil is seen in the road at the Bingham township line on Mundy brook, a mile northeast of Perryville:

and again, in the road about a mile southeast of Perryville, on the main branch of the Genesee, and near the township line.

§ 219. Exposures are few and poor in the township.

A considerable body of the Pocono and upper part of the Catskill, consisting of gray rocks, form the main mass of the highland west of the west branch, and northwest of Ellisburg; but it is in vain to make search for coal here, as all the higher formations have been removed.

§ 220. *Drainage*.—The junction of all the waters of the Genesee at the village of Genesee Forks—before making its northern course straight through New York—is a curious topographical feature.

25. *Bingham Township*.

§ 221. This township lies east of Genesee, and also against the New York State line, and is geologically exactly the reverse of Sharon township—inasmuch as the latter was shown to be covered almost entirely by Chemung rocks and soil:—while Bingham is almost entirely covered by Catskill. Three isolated tables of Pocono, enter it on the Oswayo synclinal, at its western border, and three small similar Pocono mountain tables enter it along the center of the Coudersport synclinal, in its southwestern corner. These are the last exposures of Pocono in these two synclinals, following them in a direction northeast into the State of New York. The synclinals themselves are slowly rising into the air, with the Roulette anticlinal between them; and all the Pocono and higher formations have been eroded from them to the northeast.

§ 222. *The Ulysses and Homer anticlinal* just cuts the southeast corner of the township.

§ 223. *The drainage* of the township, with the exception of two head branches of the Cowanesque creek on the eastern line, is westward into the Genesee river. Cotton brook joins the Genesee in Genesee township at Perryville; and Mundy brook, at Genesee Forks. Turner's creek, with its branches, drains the center of the township westward

past Bingham Center Post-office ; and other head-waters of the Genesee flow northwest into it in the southern parts of the township.

§ 224. *Fish bed*.—Near the southwest corner on the middle branch of the Genesee at Lyon, Pooler and Whitney's saw-mill, and on the Genesee line, there is a section exposed of about 50 feet of greenish gray sandstone, light gray sandstone, reddish sandstone, red shale and greenish shale ; the latter contain the remains of *fish*, and the light gray or green sandstone contain *fucoidal impressions*.

Fish remains are also visible in the reddish sandstone of this section,—some of which show a distinct false bedding.

Plant stems and the traces of *ferns* are visible in the greenish shales ; and the dip of the whole exposure is decidedly towards the southeast ; that is, towards the Coudersport synclinal axis.

This exposure undoubtedly represents the *fish bed horizon* near the base of the Catskill formation, and is of very great interest.

§ 225. *Red soil* and stones cover the ground a little north of Mr. W. W. Brown's house, on a fork of the Genesee, near the Ulysses line.

§ 226. *Red shale* is exposed on another fork of the Genesee, at the house of Mr. W. Daniels, about a half a mile from the Ulysses line ; and again, at the house of Mr. A. S. Warden, on one of the head streams of the Cowanesque near the Harrison line ; and again, at the house of Mr. R. H. Reed, half a mile north of the last mentioned locality.

§ 227. *Catskill red soil* forms the surface at the house of Mr. O. Crum, a mile and a quarter above the mouth of Turner's creek ; but descending the creek towards the mouth the geological indications change.

§ 228. *Boulders* and masses of sandstone, weathering whitish, are seen on a fork of the Genesee, half a mile above the mouth of Turner's creek.

§ 229. *Catskill exposures*.—*Red soil* is shown in the road on Turner's creek, about three quarters of a mile above, or

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northeast, of Bingham Center; and again, a mile and a half west of north from Bingham Center.

Red shale is exposed in the road pretty low down, near the house of Mr. H. D. Ives, two miles and a quarter east of north from Bingham Center.

Red soil shows in the road near the northeast corner of the township, a little northeast from Mr. J. L. Raymond's house, and a quarter of a mile from the Harrison line.

Red shale is exposed in the road between the cemetery and Mr. C. L. Hoyt's house, a quarter of a mile from the New York state line, and about a mile and a half from the Harrison line.

Red shale is exposed in the road near the house of Mr. S. Howe, about half a mile south from the New York state line, two and a half miles north from Bingham Center.

Red soil occupies a cross road in the northwest part of Bingham, near the house of Mr. W. Spencer, a quarter of a mile from the New York state line;—also in the road, at the Genesee township line, near the house of Mr. Hill, on Mundy brook.

Red shale is exposed in the road half a mile west of Mr. B. L. Graver's house, on Cotton brook.

Red soil is seen in the road near Mr. J. Coulston's, on the Genesee river, and a quarter of a mile from the Genesee line.

§ 230. At all these points, and in many others, the characteristic color—and sometimes the characteristic rocks of the Catskill series in place, may be seen; and their number prove what was said before, that nearly the entire surface of the township may be considered an outspread nearly of all the horizontal Catskill rocks.

§ 231. *Chemung areas.*—To recapitulate:—there are six small areas of Chemung rocks in the township, all of them confined to the bottoms of shallow valleys of as many streams.

The principal one is at the confluence of Turner's creek, with the Genesee river, on the low crown of the Roulette anticlinal.

A second is in the southeast on a fork of the Upper Genesee, on the Ulysses anticlinal.

A third is at the head of Marsh brook, two miles and a half northeast of Bingham Center.

A fourth is on a small stream running from near Bingham post-office to the State line, at a distance of about a mile.

A fifth is in the extreme northeast corner.

In all these cases a very small part of the extreme upper limit of the Chemung forms the bed of the stream, and rises for a few yards on the bordering hillside.

§ 232. *Pocono patches.*—One of these mountain relics rises between Mundy and Cotton brook; a second between Cotton brook and the Genesee; a third west of the Genesee, on the Genesee township line; a fourth lies a mile south of Bingham Center; a fifth between the Genesee river and its first branch to the west; and a sixth, west of said branch, on the southern line passing over into Ulysses. On none of these, of course, can any Coal measures be imagined.

§ 233. The student of *topography* will find in the course of the Genesee river, a parallel to that of the Tioga river in Tioga county; inasmuch as the Genesee river cuts through the two ends of the two synclinal belts of Pocono mountain—one in the Coudersport synclinal, and one in the Oswayo synclinal—just as the Tioga river cuts through the end of the Pocono mountain at Tioga; and Shrader's creek cuts through the end of Pocono mountain near Towanda, in Bradford county. In all these cases one or more mountain tables are left on the eastern side of the rivers—as the last exhibition of the upper rocks in the central line of the synclinal. The knobs thus left isolated from the main range are striking features in the scenery of the country.

26. *Harrison Township.*

§ 234. This township occupies the northeast corner, adjoining the New York State line and the Tioga county line, and is a great open country of belts of Catskill, subdivided by wide shallow valleys of Chemung, along the waters of the Cowanesque river,—Marsh brook, and the North Fork being its principal affluents.

The Chemung is brought up in these valleys by the wide, flat Ulysses and Homer anticlinal, which crosses through the center of the township on a course about north 20° east, south 20° west.

The extreme thinness of the *Catskill* formation is plainly revealed by the fact that the Chemung rocks form the bed of the middle fork of the Cowanesque near White's Corners, even in the very center of the Coudersport synclinal, which passes through that village.

The Coudersport synclinal must therefore here be a merely nominal trough, having a calculable south dip on its northern side, but almost perfectly horizontal rocks from White's Corner to the Ulysses anticlinal. The southeastern dip from this last line (the anticlinal axis) must be much more pronounced, inasmuch as the whole drainage of the county is southeastward;—first across the Coudersport synclinal, and then across the Ulysses anticlinal—with-out seeming to take any notice of these axes,—towards the Pocono mountain belt, which occupies the southeast corner of the township.—the Cowanesque river leaving it exactly at the corner.

§ 235. *Catskill hill tops*.—All the hills in the county are capped with the soft red shale beds of the *Catskill*, except those in the southeast corner; but all the streams have cut down into the *Chemung*.

Throughout the great expanse of the *Catskill*, west of Harrison valley and south of the Cowanesque river, none but the lower beds of the *Catskill* formation have been left to form the surface; and these consist of thin beds of red shale.

Most of the red beds in the northern half of the township are thin, none of them exceeding in mass three or four feet. They may be noticed exposed at many points in the neighborhood of White's Corners, and are frequently cut through in digging wells. Loose stones in the bed of the Cowanesque occasionally contain *fossil shells*, but they are *Chemung* species.

A creek, coming from the west into the Cowanesque at Dodge's mill, in the southeastern corner of the township,

has cut its channel at the foot of the Pocono slope—in which slope the upper beds of the Catskill must be concealed.

§ 236. *The Pocono rocks*, here crossing the southeast corner of the township and occupying the highland on both sides of the Cowanesque with a southeast dip, consist of gray sandy beds, diagonally laminated.

§ 237. To mention some isolated facts, attention may be drawn to an exposure of gray beds—probably Chemung, but without fossils—a little north of Harrison Valley village in the banks of the creek.

§ 238. A belt of reddish soil crosses the road about half a mile northwest of Harrison Valley village, near the house of Mr. Buck. This belt is a hundred feet wide; the soil and stones are gray; among them are masses of a whitish or grayish sandstone, which again may possibly represent the *Chemung conglomerate* of Bradford county. The hill, half a mile further on at the house of Mr. D. Hunter, is capped, however, with Catskill red shale.

§ 239. Angular fragments and masses of the same sandstone just mentioned—weathering whitish or light gray, but containing red spots and streaks—may be seen a half a mile to the northwest of the last locality, at the house of Mr. O. H. Perry.

§ 240. The same *Chemung?* sandstone also occurs in loose fragments along the creek, about a mile north of Harrison valley.

§ 241. *Red shale* is in the road at White's Corners, and at a school-house just east of White's Corners, and near the house of Mr. N. M. Johnson,—about a mile east of White's Corners.

§ 242. Gray and reddish shale is exposed in the road near the house of Mr. D. Rooks, and red shale near the house of Mr. G. Scovell.

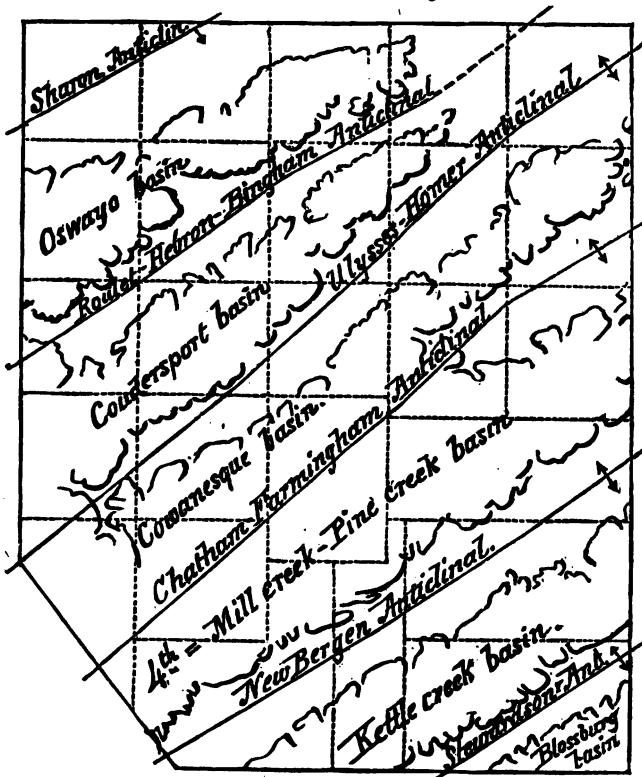
§ 243. Red shale may be seen in the road, near the house of Mr. J. E. Jones, on the south side of the Cowanesque; and again, at two places near the forks of the road east of Mr. J. Vanlou's; and again, in the road near the house of Mr. L. Dennis.

§ 244. A grit or grindstone is exposed in distinct layers in the banks of the Cowanesque, on the land of Mr. L. H. Holcomb, about a mile below—that is southeast of Harrison valley. If not suitable for grindstone, these layers will certainly afford excellent building stone, and dressing nicely. The color is light gray with minute specks of brown.

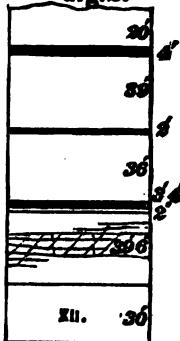
These sandstone beds are overlaid by gray shales, containing poorly preserved fossil shells and dipping very gently towards the southeast. They probably come in near the top of the Chemung formation.

§ 245. *The Cleaver's rock*, in descending the Cowanesque, disappear under water-level about a quarter of a mile below Harrison Valley Post-office, at the house of the Rev. B. Thomas. The river thence flows in Catskill. Further description of the outcrops of these formations is unnecessary, as the reader will have the colored geological map of the county before him.

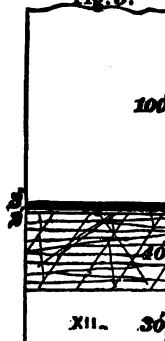
Potter County.



Whitemore Run N. 1.
Fig. 2.



Whitemore Run N. 2.
Fig. 3.





CHAPTER IV.

*Description of Potter County in 1841 and 1846.**

§ 246. "The great rolling plateau of the Allegheny mountain, in which Pine creek and the Susquehanna river, with its numerous branches, cut their way 1,000 feet below its general surface, has not, until within a few years past received any contributions from the foreign or domestic centers of emigration. It remains almost what it was a century ago, an unbroken forest, tenanted by the panther, bear, deer, wolf, and fox.

"The soil is cold, but produces excellent wheat—not, however, in heavy crops. The grasses are the natural staple of the cleared bottom-lands of Pine creek.

"Across this region the Jersey Shore and Coudersport turnpike passes, ascending its S. escarpment, where Pine creek issues from it 4 miles from Jersey Shore. The ascent is 2 miles long; the whole distance to Coudersport, about 80 miles. For 68 miles of this road, at the time of our last visit in 1846, the traveler passed the doors of only six houses, while thirteen other families resided at greater or less distances from it, in the forest to the right and left. Three of these were Irish settlers living at the head of Chatham's run, and holding correspondence with the world through Jersey Shore. Four others, the extreme E. families of the settlement, were upon the S. fork of Kettle creek, a settlement numbering, in 1846, thirty-three families, and communicating, by canoe navigation, through an uninhabitable gorge of 8 miles, or by "Boon's road," 14 miles across the mountain, with the main Susquehanna, above Young-Woman's town. In such a country, with the small means

* Surveyed cursorily by J. P. Lesley, in 1811, and by Professor H. D. Rogers, 1846, by whom the text of this was written and published in 1858. See *Geology of Pennsylvania*, Vol. II, p. 528.

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at our command, little could be accomplished beyond merely noting the general phenomena, sufficiently indeed, as in the end appeared, to enable us to announce the economical value of its geological contents.

"A low ridge, perhaps 100 feet in height, called the Sand-stone ridge, and ranging from the head of Queen's run E., upon the general table-land, terminates with a beautiful rounded and terraced end, at the turnpike near M. Focht's house, 11 miles from Jersey Shore, and 5 miles back from the edge of the mountain, if measured diagonally along the turnpike. Here, upon the turnpike, and marked by the bench in the ridge's S. side, is the outcrop of what is probably the only coal-bed in the region. Its outcrop is repeatedly marked upon the turnpike between this place and Mr. Heard's old settlement, 23 miles further on. It is always seen to be covered by reddish friable shales. In many places it appears to be rather two beds than a single one, separated by several feet of intermediate rocks.

"Mr. Heard's tavern is situated in the Third Basin, and the coal, 1 foot thick, was once opened upon his land. It outcrops in a well-marked bench upon the road, 1 mile N. of his house. Here, as in many other places, the disintegration of the Seral conglomerate produces a fine white sand, well adapted to the purposes of the glassmaker. It is said that, in sinking the well at Mr. Heard's clearing, coal of good quality, and 3 feet thick, was struck at a depth of 20 feet below the surface. This would show its place to be from 40 to 50 feet above the conglomerate.

"The turnpike enters Potter county at its S. corner, and leaves it at its N. W., not far from Olean Point or Hamilton village, in the State of New York.

"After passing the N. outcrop of Heard's coal bed before mentioned, one passes 8 miles over Vespertine sandstones, and also flats covered with a reddish irony soil, doubtless due in some measure to the presence of Umbral red shales. All this distance the land is very high, and gently rolling; but now suddenly commences a deep descent to the bed of Kettle creek, by the valley of one of its tributaries, which excellently illustrates the sharp plowing action of the

denuding floods, which swept across the country, leaving it ravined and trenched as we see it.

"The abrupt heading-up of such a valley upon the comparatively dead level of the table-land is remarkable, and may be compared with the ravines (on an infinitely smaller scale) effected in the soft banks of the streams of the sea-coast, by the yearly rain-drainage, wherever the cultivation of the soil had been neglected.

"The third axis crosses the road between the forks of Kettle creek, bringing in sight in its deep valley the upper rocks of the Vergent series.

"After crossing the West Branch, the road rises again to the summit-level, and is made to follow for several miles the crest of a "hog-back," where the traveler looks right and left down two steep slopes into two parallel valleys, each many hundred feet below him. This is composed of Vespertine grey sandstone, excepting two long flats covered with the above mentioned red soil, and two small unconnected patches of Seral conglomerate, which here seems to be a fine-grained white sandstone.

"The conglomerate does not occur again on the road to Coudersport, although the latter keeps upon the high ground across the fourth axis, and into the Fifth basin. There the road descends into the valley of the Allegheny river, where the upper mixed strata of the Vergent series appear upon it.

"It will thus be seen that on this road there appears no sign of coal in the Fourth or Wellsborough basin, although the mountains in that basin, at the elbow of Pine creek, contain the lower bed, as does also the high land crossed by the road at Hearod's, in the next basin to the S. It remains yet to be seen if the coal appears where the basin is crossed by the Driftwood Branch of Sinnemahoning. The wildness of the country effectually prevented a nearer approach to certainty, though such might readily be obtained by a camping party.

§ 247. *Notes to the above, by Mr. Platt.*—My recent survey of Potter county found little of geological importance

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to add to the above report made in 1846; but certain corrections of it are needful.

The coal-measure areas of Potter county, all told, are very small, and very little developed. This high watershed between the lake country and the Atlantic seaboard, is still a wilderness—the haunt of the panther, bear, deer, wolf, and fox; but not so absolute a wilderness as it was forty years ago; and, therefore, it is possible now to obtain some details of its geology which correct former misconceptions and errors, and add something certain to our heretofore meager knowledge.

The following chapters will tell what is known of the coal measures left in the Oleona, Coudersport and Pine creek coal basins, and of the stratification on the Roulette anticlinal in the Oswayo synclinal.

CHAPTER V.

*The Oleona Coal Basin.**

§ 248. The *Oleona synclinal* in Abbot, Stewardson, and Oleona townships, is a prolongation northeastward, through Potter county, of the Second Bituminous coal basin of western Pennsylvania.

The center line of the basin crosses Kettle creek, about $1\frac{1}{2}$ miles north of Oleona, (Kettle creek post-office.)

§ 249. A section of considerable importance was obtained on a small run on the east side of Little Kettle creek, on Warrant 5807, in Abbot township, and near the geological center of the basin.

Red shales and red sandstones, interleaved with greenish gray current-bedded sandstones, are the rocks at the mouth of the run; and a loose swash of reddish material shows on the hill side for 150 feet above the creek.

The hill side is steep from bottom to top; and above the first 130 feet is covered deeply with loose masses of conglomerate sandstone (XII) which have rolled and slid down from the hill top, 780 feet above the level of Little Kettle creek.

§ 250. *Coal*.—On this mountain crest, in a round knob only a few acres in extent, and with barely five to ten feet of loose cover, a *coal bed* has been opened, and coal dug and hauled to Germania and other places for blacksmiths' use.

That such a small, isolated knob of coal without hard rock cover, should have been spared in the general erosion of the plateau of XII, is remarkable.

The shallow pits from which the coal was taken are now filled up, and the bed cannot be measured. But Mr. Ashcroft, of Oleona, who was familiar with the old workings, reports that about three feet of coal was obtained.

* By F. Platt.
(69 GGG.).

§ 251. *Coal*.—He states also that another similar knob of coal exists on warrant 5808, on the extreme hill top, $1\frac{1}{2}$ miles further east. The area there is also small, and the coal three feet thick.

§ 252. A borehole, 75 feet deep, was made here, through massive hard sandstones, with a few feet of slates in a few inches of coal; apparently belonging to Formation No. XII.

§ 252. There is some conglomerate, not usually in large masses, on the hill crest, *west of Little Kettle creek*, in the center of the basin, but not so much as on the *east* side of the creek.

§ 253. On the east side of Little Kettle creek the massive conglomerate makes the hill crest not only on warrant 5807, but for nearly one mile north of it; but there is little, if any, south of the south line of that warrant.

The basin is narrow, and XII at this place does not catch on the highest hill tops, except for about 1 to $1\frac{1}{2}$ miles, just in the center of the synclinal.

§ 254. The coal bed mentioned above may possibly be the lowest coal bed of the Lower Productive coal measures lying on top of the conglomerate of XII. But to judge from the imperfect exposures, it seems much more likely that the massive conglomerate layer through which the borehole passed for 75 feet is the bottom layer of XII, and the coal simply an enlargement, over a small area, of one of the coal beds included in the body of the conglomerate.

If this be so, and the bottom layer of XII be 80 feet thick, there remains 700 feet of measures between the bottom of XII and the creek.

§ 255. The *Mauch Chunk* red shale (XI) is apparently thin through all of this region, but it is impossible to get an accurate section of it where there are no developments for coal or iron ore, trial shafts or boreholes. Lying as a soft rock, between the massive layers of XII above and of X below, it can make no show on a steep hillside, and must always be deeply covered under broken masses of XII; or if XII be gone from the hilltop, then it is almost certain

that XI has gone with it, and that some of the massive upper layers of X will crown the mountain crest.

Giving to XI fifty feet of thickness, which is probably somewhat more than it is here entitled to, there remain 650 feet to the level of Little Kettle creek.

§ 255. *Pocono Sandstone, X.*—This vertical space of 650 feet is in large part, if not entirely, made up of Pocono sandstones, massive and shaly, green-gray, and red.

It is true that there is much deep red showing for the 130 feet above the creek level. But the deep red coloration is extremely deceptive. Given green-gray thin sandstones for say four fifths of some hillside, but overlaid by one fifth of deep red clay shales and slates, easily disintegrated, the whole hill slope will be covered with a red wash.

So of the 130 feet above the level of Kettle creek, the greater part of the county rocks are probably greenish-gray sandstones, although the red layers interleaved among them make the chief surface show.

Judging from the thickness of X, as shown in the hillsides of Wharton township on the Sinnemahoning, the level of Kettle creek in the center of the Oleona basin must be at the bottom of X, near the top of the Catskill, (IX.)

§ 256. The basin in these townships is far removed from communication with railroads, and there is nothing in the coal-show to invite such communication.

For all commercial purposes the Oleona basin, as it passes through Potter county, is of no mineralogical importance, and the region will presumably retain its wild character for a long time to come.

CCG.72.

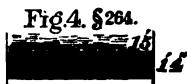


Fig. 5. § 287.

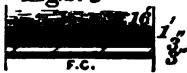


Fig. 6. § 272.

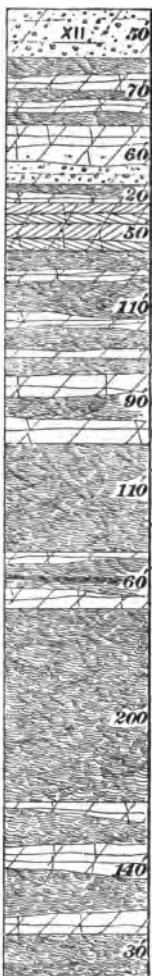


Fig. 7. § 279.

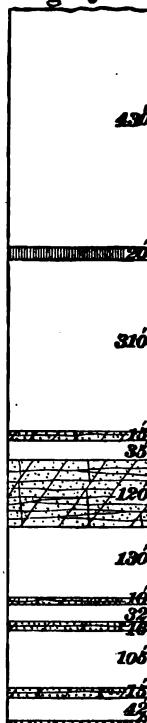


Fig. 8. § 281.

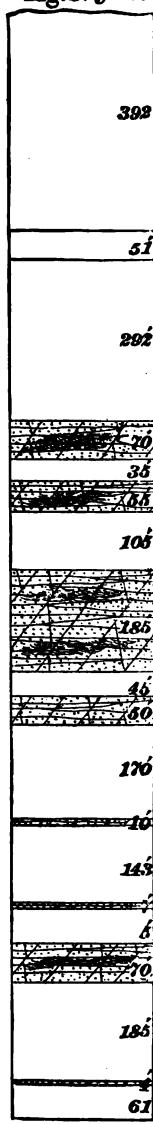


Fig. 9. § 288.

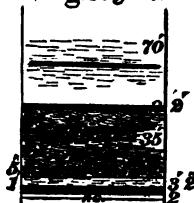
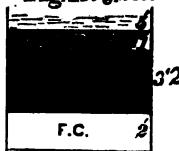


Fig. 10. §. 289.



CHAPTER VI.

The Coudersport Coal Basin.

§ 257. The Coudersport synclinal has a well defined canoe shape, holding in the center of its deepest part a portion of the Pottsville conglomerate (XII.)

It is possible that it may hold all of XII, and that the small coal opened near Coudersport is in the true Lower Productive coal measures. But it seems more probable that only the lower and middle members of XII are present, and that the small coal bed opened here lies in and not on the conglomerate.*

§ 258. The Allegheny river after flowing south, turns sharply west at Coudersport. This bend of the river bounds the basin of conglomerate on the east, south and southwest. The northern limit of the basin is clearly enough defined by a high crest of conglomerate with cliffs and broken masses.

§ 259. The anticlinal axis which governs the south limit of the basin is plainly traceable, and the northward dips from it into the basin are rather strong.

At Coudersport, which is outside of the basin to the southeast, the Pocono sandstones (X) occupy the ground at the level of the Allegheny river, and for 300 or 400 feet up the slopes ; the river here flowing at about 1,640 feet above the sea. But two or two and a half miles south of Coudersport, on the Homer road, is the *bottom of X*, 2,450 feet above ocean level, and rising steadily towards the Homer and Sweden valley anticlinal ; and the effect of all this is to confine the basin of Pottsville conglomerate to the *north* side of the river.

*If this view be correct this coal bed will correspond to the Sharon, or perhaps to the Mercer coals of western Pennsylvania. There can be little doubt of its representing the Alton or Buttsville coal of McKean county.

§ 260. The Roulette-Hebron anticlinal defines the northern limits of the Coudersport synclinal; bringing up Chemung* rocks at Roulette in the deep valley of the Allegheny river. Between these two anticlinal axes lies the Coudersport basin.

§ 261. *Coal.*—Some trial openings were made in the Coudersport basin more than 40 years ago, and a small entry driven into the coal bed, which was reported to show 16 inches of coal at the outcrop and from 3 feet to 3 feet 11 inches of coal at the face of the heading, the coal still increasing in size as the drift went into the hill. These measurements are given not as hearsay, but as actual facts, in the Geology of Pennsylvania, Vol. II, page 546, 1858, and they have been accepted as true until this summer of 1879, when a regular investigation was made preliminary to a serious development of the basin.

It now appears that the coal could not have been seen by Prof. Rogers except at the outcrop, where it was correctly measured and recorded by him as 16 inches thick.

For its thickness in the drift, then filled with water, reliance was placed on the alleged measurements at various points of the gangway, furnished by Mr. J. L. Nelson; and as no quotation marks were used in the report, much error and some loss has been the consequence.

§ 262. *Divisions of XII.*—The exposures now made in the basin, though not quite complete, are sufficient for constructing a section, from which to judge of its value.

The gray, massive, sandstone layers beneath the coal measure 60 or 70 feet in all; contain a good deal of conglomerate, and breaks off in huge blocks and masses. This is presumably the *bottom member of the Pottsville conglomerate, XII.*[†]

The middle member of XII.—Fifty feet of measures overlie the massive rocks just described. About 15 feet above the base of this middle member a coal bed has been

* According to Mr. Sherwood's map.

† Compare the *Shinersville conglomerate* of the Report GG, on Sullivan county; and the *Olean conglomerate* of Report R, on McKean county.

opened in several places ; and this is the bed incorrectly described as 3 feet 11 inches thick. See § 261 above.

§ 263. *Coal in XII.*—Various openings now show that the coal bed does not contain *on an average* more than from 12 to 16 inches of coal, and even that small total of coal is always distributed between layers of slate or rock.

In all cases the coal rests on plastic fireclay and is overlaid by dark colored clay slates.

§ 264. In a recent shaft, 18 feet deep, the bed was found thus, fig. 4 :

| | |
|-----------------------|-------------|
| Surface stuff, | about 3' 0" |
| Slates, dark colored, | 15' 0" |
| Coal, | 1' 4" |

§ 265. A drift into the outcrop 50 feet off showed 13 inches of soft, rotten coal, underlaid by soft, plastic clay ; with slates above, dark colored, but much eroded and broken at the outcrop.

§ 266. A drift was put in on this coal bed many years ago, on the west side of Nelson run and north of the openings already described. It had fallen shut, but the stuff lying near the drift mouth showed that the coal was much mixed with slate. At the outcrop black slates could be seen, overlying 1' to 1' 3" of coal, with a plastic fireclay floor.

§ 267. On the east side of Nelson run a shaft has been put down to this same bed, which is here at a level about 80 feet lower than at the old openings, the measures sinking to the south towards the center line of the basin, which is near the shaft. The measures passed in the shaft were as follows, fig. 5 :

| | |
|------------------------------------|--------|
| Slates, brownish and dark colored, | 16' 0" |
| Coal, | 1' 0" |
| Rock parting, | 0' 3" |
| Coal, | 0' 3" |
| Soft plastic fireclay. | |

A specimen of the coal was analysed in the laboratory by Mr. McCreathe :

| | |
|------------------|--------|
| "Water, | 1.150 |
| Volatile matter, | 34.185 |
| Fixed carbon, | 54.276 |

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| | |
|-----------------|---------|
| Sulphur, | 1.059 |
| Ash, | 9.330 |
| | <hr/> |
| | 100.000 |
| Coke, per cent, | 64.665 |
| Color of ash, | grey. |

The coal, somewhat coated with infiltrated silt, is compact and brittle, with deep black luster."

§ 268. *A lower coal.*—At the old drift an opening was made on another coal bed, 40 or 50 feet *below* the bed above described; only six inches of coal at the most: sandstone above and below; worthless and unreliable.

§ 269. *A higher coal.*—There is the show of yet another small and worthless bed in the hill side, 45 or 50 feet *above* the main coal bed. It is evidently small, and underlies only a small area in the center of the basin.

§ 270. On the east side of Nelson run, 15 to 20 feet below the coal bed in the trial shaft, the conglomerate outcrops in great mass on the hill side; the rocks between it and the coal seeming to be chiefly clay slates.

§ 271. *Subconglomerate measures.*—The exposures of XII and underlying rocks in the Coudersport basin are very imperfect.

In 1877 Messrs. Carll and Ashburner made a section of the rocks underlying the coal measures in northwestern Potter county, for the purpose of comparing them with the measures in McKean and Elk counties, with the following general result:

§ 272. *Compiled vertical section of rocks exposed in Roulet, Eulalia, Clara, Hebron, and Sharon townships:—Fig. 6.*

| | |
|---|------|
| OLEAN CONGLOMERATE, (bottom member of XII,) | 50' |
| Sandstones and shales, | 70' |
| SUB-OLEAN SANDSTONE and conglomerate, | 60' |
| Shales and sandstone, with red layers, | 20' |
| False-bedded sandstone and shale, | 50' |
| Gray shales, with bands of red shales and sandstone, | 110' |
| Gray shales and sandstones, | 90' |
| Red shales, containing gray shales and flags, | 110' |
| Gray sandstones and shales, (fish bed,) | 60' |
| Red shale, with probable alternations of gray and green shales, | 200' |

| | |
|---|------|
| Shale and sandstone, containing fish bed, and concealed rocks underlying, | 140' |
| Olive shale, | 30' |
| Red shale, Chemung fossils, | — |
| Total, | 990' |

§ 273. Coudersport lies south of the basin, as has been said. The rocks at Coudersport are greenish gray micaceous current-bedded and thin bedded sandstones; quarried for flagging and in-walls; soft and easily dressed; containing numerous impressions of fossil plants, many thin carbonated layers being found in the bed plates.

§ 274. *Pocono limestone*.—A *calcareous clay iron stone* is found in the measures near the level of the Allegheny river at Coudersport; it possesses no practical value; except as a guide to the geologist, in determining his place in the Pocono (or Vespertine) Series, No. X.

§ 275. *Quarries*.—Greenish gray micaceous sandstone, with some few red layers show on the hill side along the road which ascends (northwest) from the north end of Coudersport, to a height of from 260 to 300 feet. The sandstone as exposed in quarrying dips gently to the north-northwest into the Coudersport basin.

Above this there are say 100 feet of concealed measures. Above this massive gray sandstone, with *conglomeratic layers*, is seemingly in place at about 400 feet above the village.

The crest of the hill, 180 feet above this sandstone, is covered with conglomeratic sandstone in fragments.

There is no opportunity for determining where the shales of XII occur.

The top of the mountain west of the Allegheny river and northwest of the village of Coudersport, is made by the rocks of XII.

§ 276. *Conglomeratic boulders*.—The center line of the basin crosses the Allegheny river some $2\frac{1}{2}$ miles north of Coudersport. Masses of XII here fill the river valley.

The eastern heavily wooded hill-side shows no section, but an examination of the hill top shows that the bottom layers of the conglomerate (XII) have caught on the hill crest. But while it is thus seen on the hill top only along

the center line of the basin, the greatest *surface show* of the massive *conglomerate boulders* is fully 1 mile or $1\frac{1}{2}$ miles to the south, on the crest of the hill of X overlooking the valley of Mill creek, east of Coudersport. From this hill top to the valley of Mill creek the surface is covered with masses of XII, while X is clearly the country rock on the hill top.

Moreover this *transported material of XII* has crossed the valley of the Allegheny river in the region west of Coudersport. There is no XII in place south of the Allegheny river, but it makes the high hill tops of the Coudersport basin, north of the river: yet great masses of XII are found *in the ravines* leading into the river on its south side, from the level of the river bed up, for 140 or 150 feet; but above this height they are *not* found in any of the ravines, but are found in all the ravines, up to that terrace.

What is described above is true of many other places in this northern tier of counties; and manifold are the errors and misconceptions which have been caused by these great masses of XII lying packed closely together far down the slope of a hill the very crest of which frequently rises no higher in the geological series than the middle of the Pocono formation.

. § 277. But while the conglomerate of XII crowns the hill crest on the ridge between the Allegheny river and Dingman's run, northwest of Coudersport, yet the basin is pointing out to the east and the bottom of XII scarcely more than catches on the crest.

§ 278. The Coudersport basin is limited between Dingman's run on the east, and a point about 1 mile west of Coal run on the west. Its north edge is a huge ridge of massive conglomerate (XII) rising steeply from Trout run; and its *greatest width* is between one and one and a half miles.

CHAPTER VII.

The Hebron Anticlinal and the Oswayo Synclinal in Potter County.

§ 278. The Roulet-Hebron anticlinal, north of the Coudersport basin, separates it from the Oswayo synclinal.

Where this well defined anticlinal crosses the Allegheny river, near Roulet P. O., it brings up *Chemung* rocks.

Its axis or center line passes close to the village of Hebron, (about 2,100 feet above ocean level); and crosses the deep valley of Allegheny river at Roulet (1,530 to 1,550 feet above ocean level.)

At Hebron, therefore, the lowest rocks exposed on the anticlinal should be those strata of the *Catskill* (IX) which lie only about 180 feet (by barometric observation) beneath the base of the *Pocono* (X.) This junction plane between X and IX exhibits itself in the hillside just north of Hebron.

§ 279. *An oil boring at Hebron* furnished the following record : Fig. 7.

| | | | |
|--------------------------------------|----------|----|-------|
| Surface, | 0' | to | 0' |
| Interval unrecorded, | 430' | to | 430' |
| Sand? [an <i>impure limestone</i> ,] | 20' | to | 450' |
| Interval, | 310' | to | 760' |
| Stray sand, | 15' | to | 775' |
| Interval, | 35' | to | 810' |
| Sand? | 120' | to | 930' |
| Interval, | 130' | to | 1000' |
| Sand? | 10' | to | 1070' |
| Interval, | 32' | to | 1102' |
| Sand, | 18' | to | 1118' |
| Interval, | 105' | to | 1223' |
| Sand, | 15' | to | 1238' |
| Interval, | 12' | to | 1280' |
| Sand, | 3' to 6' | to | 1286' |

§ 280. *Chemung limestone*.—The “sand” struck at 430' is really a somewhat impure limestone rock. If the top of the well be some 180 feet below the bottom of X, as appears

to be the case from the section on the Hebron hill, then this limestone is 610 feet below X, and would come into the Chemung rocks, (for the Red Catskill is in this part of Potter county apparently less than 500 feet in thickness,) and must in that case represent, more or less, one of the Mansfield beds.

A bed of *limestone* is reported to crop out in Harrison township, at the northeast corner of Potter county, and to be burned for agricultural purposes, although poor and *ferruginous*. According to Mr. Sherwood it lies in the junction layers of the Chemung and Catskill groups;—and it may very probably represent the limestone opened and worked extensively on the Loyalsock, three miles above Forksville, in Sullivan county.

There is no other place in Potter county, however, where this limestone has been recognized by the Survey. But its outcrops in the forest have no doubt been discovered by the aborigines; and the widely spread, and almost equally widely believed tradition, that the Indians still return even now to the forests of these northern counties of Pennsylvania to secure such lead and silver as they can remove, and then cover up successfully all traces of their workings, may have some slight foundation of fact, since many streaks of *galenite* occur in the quarries on the Loyalsock, out of which patient labor might extract enough lead to suffice for the supply of the limited wants of savages.*

§ 281. A borehole put down in Harrison township, (starting about 1620 feet above tide, according to report,) and presumably with the top of the well in rocks near the top of the Chemung, shows the following record:—Fig. 8.

| | | |
|---|------|---------|
| Surface, | 0' | 0' |
| Interval, end of casing, <i>gas</i> , | 392' | to 392' |
| Interval, <i>found salt water at bottom</i> , | 51' | to 443' |
| Interval, | 292' | to 735' |
| Streaks of sand and shell, | 70' | to 805' |
| Interval, | 35' | to 840' |
| Sand, | 55' | to 895' |

* It is more likely, however, that the numerous local traditions of this kind relate to artificial hiding places in which the natives stored metallic treasures purchased from the whites, from whom alone they could get firearms.

| | | | |
|--|------|----|-------|
| Interval, | 105' | to | 1000' |
| Streaks of sand and shell, | 185' | to | 1185' |
| Interval, | 45' | to | 1230' |
| Sand, | 50' | to | 1280' |
| Interval, | 170' | to | 1450' |
| Sand, | 10' | to | 1460' |
| Interval, | 143 | to | 1603' |
| Sand and shell, | 7' | to | 1610' |
| Interval, | 65' | to | 1675' |
| Sand and shell, | 70' | to | 1745' |
| Interval, | 185' | to | 1930' |
| Sand, | 4' | to | 1934' |
| Interval, to bottom of well, | 61' | to | 1995' |

§ 282. *The Oswayo synclinal* runs parallel to and north of the Roulet-Hebron anticlinal.

§ 283. Going north from Hebron P. O., by the straight road to Clara P. O., the mountain top (a broad, double crest, with a shallow valley between,) is reached about $2\frac{1}{2}$ miles from Hebron, on warrant 5,897; and its height above the village is (by barometer) only 280 feet, ($2,370' \pm$ feet above tide.)

The junction plane of IX and X seems to lie about 180 feet above the level of Hebron.

The broad upland along this road across the basin is clearly made up of the measures of X. The rocks are evidently Pocono sandstones, sometimes quite massive, and usually much current-bedded.

§ 285. Going down the hill towards Clara P. O., on the north side, these gray and greenish sandstones of X continue to crop out down to 360 to 400 feet below the upland. Here the top layers of IX appear, and below this, to the base of the hill, about 250 feet, red slates and sandstones of IX are the country rock along the road.

§ 286. Leaving the main road 1 mile south of Clara P. O. and returning by a road which re-crosses the basin $2\frac{1}{2}$ miles or so west of the road already described, the summit of the Oswayo hills is crossed on warrant 3439 in Clara township.

Many loose boulders of conglomerate sandstone, (made up of massive gray sandstone with layers of small white quartz pebbles) are found lying loose over the crest; which is 2,330' (by barometer) above ocean level.

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There is no continuous sequence of strata, however, visible on the way up the hillslope, sufficient to indicate with certainty the presence of XII on the crest. The masses on the extreme crest come in suddenly and seem to cover only a moderate area. Their appearance would rather suggest a sort of glacial moraine, than a formation of rock in place.

The great boulders of conglomerate which cover the ground at Hebron, resting directly on the red rocks of IX are boulders of XII, and have plainly been brought to the locality where they lie from a distance; by ice or other agency; and perhaps the same agency is responsible both for the masses of XII on the crest of the Oswayo hill, and for those which so thickly cover the surface of the ground over a few acres at Hebron.

CHAPTER VIII.

The Pine creek coal basin.

§ 287. This Mill creek-Pine creek synclinal is a prolongation, east north eastward, of the Third bituminous coal basin of Western Pennsylvania. It lies next north of the Oleona basin or Kettle creek synclinal, from which it is separated by the Germania or New Bergen anticlinal.

The top layers of the Catskill formation (IX) are to be seen 40' above the water of the west branch of Pine creek in the center of the synclinal.

Layers of Catskill, (some hundreds of feet beneath the top of the formation) are seen on the crest of the anticlinal 780' above the Pine creek water bed, two miles distant.

Consequently the fall in dip in two miles from the crown of the anticlinal to the center line of the basin must be at least 1250' or 1300'.

The basin structure is very evident, and is strongly marked by the topography of the district.

The soft red rocks of the anticlinal cover its broad back and make smooth farming land, successfully cleared and cultivated.

Towards the synclinal Pocono sandstone strata (X) come in, and rugged hill slopes begin, growing steeper in the basin, and getting covered with broken blocks of the massive Pottsville sandstone (XII).

§ 288. The coal producing part of the basin lies north of the west branch of Pine creek. For, although some of the highest hill tops to the south *may* be capped by the bottom layers of the conglomerate, XII, none were seen.

The Pine creek coal basin in Potter county is merely the westward prolongation of the *Gaines coal basin* of Tioga county; a description of which is given in Report G.*

* See pages 229 to 233.
(88 GGG.)

The Lower Productive Coal Measures are caught in the hills, on the continuation of the Gaines coal basin to the westward in the country lying between the west branch of Pine creek and the main stream or east branch of Pine creek, in Potter county.

Coal is opened on the outcrop for examination in numerous places, and on Whittemore run it has been drifted into until solid coal was worked under good cover.

The principal opening on the west side of the east branch of Whittemore run, is about 2160' above tide, and 690' (by barometer) above the Rorybacker house, where the run enters the west branch of Pine creek.

A vertical section on Whittemore's run was compiled from imperfect exposures, thus :—Fig. 9.

| | |
|---|---------------|
| Surface. | |
| Concealed measures (holding a small coal?) | 65' to 70' 0" |
| <i>Coal, reported</i> 2' thick, | — |
| Imperfectly exposed measures but apparently nearly all sandy gray slates and shales, | 35' 0" |
| Clay slate, | 5' 0" |
| Black slates, | 1' 0" |
| <i>Coal</i> , | 3' 2" |
| Fireclay (?) | 2' 0" |
| Concealed measures, | 40' 0" |
| Massive conglomerate S. S., | — |
| Total, | 156' 2" |

The reputed coal bed in the upper part of the section was not seen at all, and has never been opened.

The "2 foot" coal was struck in a 10 foot trial shaft. Pieces of coal thrown out upon the surface indicated a bed of hard compact, firm, cuboidal coal, with a high percentage of volatile matters.

§ 289. The chief bed of the region, and the only one as yet fairly opened for examination, (40 feet above the massive conglomerate sandstone) is entered by a gangway on a course of north 80° west. The coal dips plainly to the southwest, and the butt of the coal is northwest.

The mine was partially drowned ; but about 15 yards in from the crop, the bed could be measured, thus : Fig. 10.

| | |
|-------------------------------|-------|
| Clay slate, | 5' 0" |
| Black slate, | 1' 0" |
| Coal, | 3' 2" |
| Fireclay floor, (?) | 2' 0" |

Some lens-shaped slate layers were noticed in the bed, but no regular slate parting. The coal is hard, and mines out well; is of a jet black luster when freshly broken, and has a cuboidal fracture.

An average specimen forwarded to the laboratory was reported thus by Mr. McCreath:—

"The coal, generally coated with silt, has a deep black, shining luster on clean fracture; it is compact and firm, and has a few thin partings of slaty coal."

The coal, when analysed, seemed quite wet.

| | |
|----------------------------|---------|
| Water, | 3.070 |
| Volatile matter, | 30.970 |
| Fixed carbon, | 55.140 |
| Sulphur, | .975 |
| Ash, | 9.845 |
| | <hr/> |
| | 100.000 |
| Coke, per cent., | 65.96 |
| Color of ash, | cream. |

The high percentage of water in the above analysis is apparently due to the coal specimen having been accidentally somewhat water soaked while *in transitu* to the laboratory.

It is clearly an excellent coal for domestic use, or as a steam-raising coal; and if it will make a firm coke, it is also a valuable fuel for gas works' use; the percentage of volatile hydro-carbon being as great as is yielded by the Connellsville coal, and fully equal or superior to the Reynoldsburg coal percentage of gas.

An analyses of the coal from this gangway, made by Prof. C. F. Chandler, (Feb. 10, 1876,) reads thus:

| | |
|--|--------|
| Volatile combustible matter, | 31.70 |
| Fixed carbon, | 56.50 |
| Ash, | 9.85 |
| Sulphur, | 1.00 |
| Water, | 0.95 |
| | <hr/> |
| | 100.00 |

Agreeing, therefore, almost perfectly with the analysis made

by Mr. McCreathe, except that the coal not being wet, Prof. Chandler gets only the normal percentage of water.

§ 290. The conglomerate of XII shows 40' below the coal as a massive gray sandstone, containing numerous layers of white rounded quartz pebbles.

§ 291. This Pine creek coal basin was examined by Mr. Andrew Sherwood, in 1876, and he describes it substantially thus: "The basin enters Potter county, on the north side of Pine creek, and crossing the north branch above Kilbourn's hotel, keeps on the north side of it. Two or three miles above the forks are two considerable streams coming into the west branch from the north,—Whittemore run and Beech Flat brook. About two miles up Whittemore run, on the west side of the right hand draft, is seen the section given on page 36, above.

On the east side of the right hand draft, opposite the foregoing section, is seen the one given on page 37 above.

These sections, made by Mr. Sherwood in 1876, agree closely with my own in 1877.

§ 292. This same coal bed, (the 3' 2" to 3' 4" coal bed) has been opened for examination at numerous places in the region between Pine creek forks, on the east, towards Burrough's school-house on the west, a distance of about 5 miles: it lies in the hills between the branches of Pine creek, well up towards the hill tops, the elevated plateau under which it lies varying in width, but ranging, perhaps 2 miles across in the center of the basin: the basin points out to the east at the forks of Pine creek, and is apparently rising at the west at or about the Burrough's school-house.

§ 293. The exact acreage underlaid by the coal bed inside of the limits above named, could only be determined by running out the outcrop lines. When a coal lies so near to the hill tops even slight changes in structure and widening out of valleys sufficing to make great changes in acreage.

The basin lies well for mining: the coal could be easily attacked on Whittemore run and Beech Flat brook, and the valleys of these streams would be an easy outlet to the west branch of Pine creek.

Taking 3 feet 2 inches to 3 feet 4 inches as the average

thickness of the coal bed, it will yield 5,000 tons of coal to the acre.

Leaving out entirely any question of a possible western extension of this Pine creek productive basin into the hill west of Burrough's school-house, and taking only the area already named where the coal is known and proved, the basin is of value, and likely soon to be of consequence among the detached coal basins engaged in supplying gas and steam coal to Central New York State and the trade of the great lakes.

§ 294. *Railroads.*—Hitherto the basin has been far removed from a market, and with small prospects of railroad communications. But now there are two railroad outlets proposed.

The Geneva, Hornellsville and Pine creek railroad, if it should be constructed, would afford a direct route to Hornellsville, on the New York and Erie railroad, and Geneva, on the New York Central railroad, thus throwing the coal by a short route into central and western New York State.

The most important outlet however is by the Jersey Shore and Pine creek railroad. Considerable grading has been done upon this railroad, and it seems reasonably certain that it will be through in a few years. It extends from Jersey Shore (where it connects with the Philadelphia and Reading railroad) to Port Allegheny in McKean county where it connects with the Buffalo, New York and Philadelphia railroad.

The Jersey Shore and Pine creek railroad taps the coal basin and would afford an outlet to the southward to the valley of the Susquehanna, and to the northward to Buffalo, Canada and the lake trade.

These latter constitute the natural market.

§ 295. *Coal.*—Mr. McCreath made no special examination of the coke from this coal: but simply reports it as a coking coal. It enters at once therefore into competition for the gas coal trade: a large trade in northern New York. It should also make a strong and efficient steam coal: and the sulphur is low, a factor of importance in all coals going to rolling mills or the puddling furnace.

The general character of the coal is that of a *bituminous coal*.

Throwing out the accidental impurities of sulphur, ash and water, the coal shows the following relationship of volatile hydro-carbons to fixed carbon.

No. 1, as 1 : 1.7804.

No. 2, as 1 : 1.7823.

No. 1 is Mr. McCreath's analysis and No. 2 Prof. Chandler's analysis of the coal.

§ 296. The Pine creek basin continues across Potter county as a well marked synclinal, although it holds the Productive Coal Measures almost nowhere except as above described.

It crosses the Jersey Shore and Coudersport turnpike near the old S. Deven's tavern, now owned and occupied by Mr. Leighman.

Its width is fully 2 miles, but it is exceedingly shallow.

§ 297. The massive sandstone of XII, a pebble rock conglomerate, has its north wall on warrant 4677, along the pike, some 1 to 1½ miles northwest of the old S. Deven's house: while the south wall of XII is some three fourths of a mile southeast of the hotel on warrant 4679.

The elevation of the conglomerate above tide is here about 2300', and as it lies nearly horizontal and there is no higher land in the basin, it carries little of the overlying measures.

§ 298. But the clearing at the S. Deven's tavern is on soft rocks of XII apparently, and there may be some coal, if only one bed, in the center of the basin. Some borings for oil, soon to be made, will settle the exact depth of coal measures included.

§ 299. Mr. Leighman reports that pieces of coal have been brought to hand from warrant 4664, two miles northeast of his place; but he has never seen the coal lying *in situ*.

This warrant, 4664, lies directly in the center of the basin as continued westward from the openings already described on Whittemore run, or the west branch of Pine creek; and it is, therefore, on the high hill crest on the warrant that the coal might be expected to catch. It is reported as lying well up into the hilltop.

§ 300. The center of the basin, after leaving warrant 4664, seems to cross the Coudersport and Jersey Shore pike, about one mile north of the S. Deven's tavern.

In such a shallow basin, with its coal almost at the hill-top, the broad ravines would entirely destroy its coal acreage.

§ 301. There was no opportunity along the pike to secure accurate measurements of XII, or of the measures underlying it. It is clear, however, that XII is of considerable thickness; and that although its conglomerate bowlders have been carried far over the hills and scattered through numerous valleys to the north of the center of the basin, yet the conglomerate of XII is in place only in a narrow line along the center of the basin, and then only on the extreme hill crest, 2300 feet or more above the ocean level.

§ 302. The well-defined synclinal axis of the Pine creek coal basin, after crossing the Jersey Shore and Coudersport turnpike, sweeps on to the southwest through West Branch and Summit townships, into Wharton and Sylvania townships, where it crosses the deep gorge made by the Sinnemahoning branch of the Susquehanna river.

§ 303. The center of the basin crosses the Sinnemahoning north of Nelson's run, in Wharton township, two miles north of the forks of the Sinnemahoning. The east fork of the Sinnemahoning heads up in the basin, near the old S. Deven's tavern, already described, in West Branch township.

§ 304. *Coal of X.—Nelson's Coal Drift* is in a small "draft" on the east side of the Sinnemahoning creek, about two thirds of a mile south of the mouth of Nelson's run. But the so-called "coal bed" is merely an outcrop of sandstone holding thin streaks of coal, with scattered pieces of coal, always small. The sandstone holding these streaks is in all only one foot thick; and below it there are 12 inches of fireclay, also holding one small coal streak. The sandstone is near the junction of IX and X; certainly not more than 100 feet above the bottom of X, and probably less than that. The country rocks above and below the opening are gray and greenish sandstones, thin-bedded and

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much current-bedded, with some red clay slates and red sandstone layers; the prevailing color of the measures being gray and greenish gray.

Mr. Nelson has only obtained a few small coal pieces, and the layer is of no possible practical value.

The exposure resembles very closely the openings made for coal on the Loyalsock creek, near Barbour's Mills P. O., Lycoming county, already fully described in the Lycoming report in GG, and the vertical section of the measures overlying as made on the Loyalsock and on Nelson's run shows great similarity.

The coal streaks are 300 feet above the Sinnemahoning; the exposures for these 300 feet are imperfect, but seemingly the whole mass is red sandstone and red slates, with some gray and greenish-gray layers; so that the Red Catskill comes nearly up to the level of the openings.

Above the opening massive current bedded gray sandstone shows in place.

At 420 feet above the creek greenish-gray very micaceous thin bedded and current bedded sandstone is in place.

The same sandstone, somewhat more massive, shows at 510 feet and at 720 feet above the creek.

At 760 feet above the creek a similar sandstone shows in place. At this level some pieces of much coarser grained and more massive sandstone are found in the draft; but only one small piece of conglomerate rock, with rounded white quartz pebbles.

From this place up to the crest pieces of coarse grained and fine grained gray sandstones, always in small pieces cover the hillside, without any conglomerate bowlders.

The crest of the mountain is 1245 feet above the level of the Sinnemahoning creek. It is possible that the coarse sandstone on top is the very bottom of XII; but it seems much more likely that the whole mountain mass is made up of X, which would make the gray Pocono rocks at this place nearly or fully 1,000 feet thick.

§ 305. The hills on the west side of the Sinnemahoning are lower than those on the east side by from 100 to 200 feet.

If the coal measures had caught at any point of this basin on the first fork, it would have been in the vicinity of the hills above Nelson's run; and they have apparently not caught in that place.

The basin is rising out both to the north and south from Nelson's run, soon carrying the red rocks of IX far up on to the hill sides.

The synclinal of the Pine creek coal basin therefore is well defined as a synclinal basin, but has entirely ceased through these townships to be a productive coal basin, the conglomerate of XII and the Lower Productive measures having been eroded from the high plateau.

The mountain crest back of Nelson's run is by barometer 2,290 feet above ocean level.

§ 306. *On the west side of the Sinnemahoning branch*, and about 1 mile above the mouth of Nelson's run, or 3 miles above the junction of the main stream and east fork of the Sinnemahoning, there is a so-called coal opening about two thirds of the way up the mountain side, about on warrant 4776, or just south of it.

§ 307. *Coal of X.*—Mr. W. Briggs, a long-time resident, reports that years ago a small coal some 2 inches thick, was found in a ravine, about 1 mile west of the Sinnemahoning. The "measures did not appear in place" according to his statement; some few small pieces of coal were brought down and shown, but no opening was made.

The coal seems to be palpably one of the small coal streaks of the Pocono formation: most probably the same horizon as the so-called Nelson coal opening, in the small ravine south of Nelson's run, already described.

§ 308. The main road from Wharton Mills P. O. on the Sinnemahoning creek to Coudersport, follows up the main stream to the forks, and then takes up the south fork of the Sinnemahoning. It thus cuts directly across the Pine creek basin.

The whole country is a great wilderness, and the exposures are unsatisfactory, but there is no reason to believe that the Pine creek basin is at any point along the Sinnemahoning waters, where it crosses the main stream or south

fork, geologically deeper than at Nelson's run, though some of the highest crests in the basin, not visited in this examination, may possibly take in XII and some little of the overlying Coal Measures.

For the high lands where the waters of the branches of the Sinnemahoning head up in the mountain gorges is now as wild as when the First Survey passed through here in 1846: the woodman, hunter or fisherman occasionally finds his way among these wide-stretching forests: there is the usual amount of tradition of how the red Indians once extracted silver and lead from these mountain sides, and indeed tradition holds that they still return at intervals and re-open the old deposits, returning with their spoil, but never allowing the hunters or residents to discover the location of their mining ground.

But of the one valuable deposit which might exist among these mountains, a good sized coal bed, the local traditions make little or no mention.

In explanation of the wide spread belief through all these northern counties of Pennsylvania that the Indians always obtained all the lead they needed, it should be said that the large limestone deposit on the Loyalsock creek, in Sullivan county, above Forksville, showed numerous thin streaks of galenite, enough when patiently extracted, to have yielded the small amount of lead needed by the tribes of that region.

This limestone, which is well down in the Catskill(?) may be equally or more lead bearing in other localities. A continuous streak of galenite of only a few inches in thickness would easily afford an amount of lead which would have been of considerable consequence to these people. It is likely that some such quarries were known to the Indian tribes, the location being jealously guarded from the knowledge of the white settlers, and the description of its whereabouts handed down carefully for generations among the Indian tribes.

§ 309. *Resumé*.—The structure of the Pine creek coal basin is seen by following up the North fork of the west branch of Pine creek, along the main Coudersport road.

This fork is about 2 miles west of Whittemore run, and the road follows up it, cutting clear across the basin.

The center of the coal basin is about $1\frac{1}{2}$ miles up the North fork, on warrant 4649.

The hills on both side of the fork are made up of massive layers of XII; and great masses of conglomerate in huge boulders fill the valley of the creek.

At the watering trough, near the center of the basin, the road runs along well up in the measures of X, and not more than 350 to 400 feet below XII; yet on going north and northwest along the road, while the road is rising, the country rock gets still lower in X and soon reaches the measures of IX; for about 2 to $2\frac{1}{2}$ miles above the center of the basin the level of the road is fully 200 feet above the level of the stream at the center of the synclinal yet the country rock is some hundreds of feet down in IX.

There is, therefore, a sharp rising to an anticlinal axis.

The county map with this volume shows two *great* anticlinal axes crossing Potter county, the Germania axis (south of the Pine creek coal basin) running through West Branch, Abbot, Oleona, and Wharton townships, and bringing up Chemung rocks in the valleys; and the great anticlinal which enters Potter county in Harrison township, and sweeps southwestward across the county, also bringing up Chemung rocks in the valleys.

Between these two great anticlinals a smaller anticlinal axis enters Potter county at the north edge of Pike township and runs southwestward, bringing up Chemung rocks in Pike and Jackson township; but it seems to lose its force in going southwest, and through the great plateau of central Potter county, the topography shows the well-defined valleys of these great anticlinals, with one huge plateau between.

This subordinate anticlinal axis is, however, a great axis in its course through Tioga county.

§ 310. Following the main road to Coudersport up the north fork of the west branch of Pine creek, the influence of this anticlinal sub-axis, which enters through northern

Pike township, keeps the highest hilltops from taking in anything higher than the Pocono rocks of X in their crests.

On reaching Sweden township, on warrant 2132, the massive conglomerate of XII again catches the hills in a shallow basin ; its southern edge is 2450 feet by barometer above the ocean level.

The measures of XII cover this crest for about one mile in width.

At Duel's house, near the center of this basin, (2430 feet above the ocean,) Mr. Conable reports that they found ten inches of coal in digging the cellar.

Mr. Wambold reports that on their property, three fourths of a mile northeast of Duel's house, along the same crest, they struck black slate in the cellar, 6 or 8 feet below the surface, and that in digging the well they found a coal bed 11 feet below the surface.

He reports the "coal as 31 inches in all, including some slate layers, but mostly all coal ; that it increased in size 6 inches in 6 feet across the well, and dipped to the southward.

The location is on the north side of the shallow basin, and the measures should dip gently to the south.

It is possible that the whole of XII is caught on this high crest and that this coal represents the first coal on top of XII ; but it is more probably a small coal in XII, perhaps as high as the middle member of XII.

The surveys of the Jersey Shore and Pine creek railroad crossed this ridge with their experimental lines, and Mr. Ross, president of the company, reports that they found the massive conglomerate covering the crests, 2499 feet above the ocean level.

§ 311. This little basin can have no great length from east to west ; and where the old Jersey Shore and Coudersport pike crosses the center of the synclinal axis the mountain crest is made of the measures of X.

This shallow, narrow and short synclinal basin of XII has been included in the Pine creek coal basin.

§ 312. The Pine creek basin may be called a composite basin, made up of a southern basin holding coal measures

of value, an anticlinal center cutting out all of XII and coal, and one small basin on its north side, holding some of XII and a small coal bed ; and north of this small basin in Sweden township, is the broad and well defined anticlinal axis of the Homer and Sweden valley region.



CHAPTER IX.

*Notes of a reconnoissance across the hills from Roulet to Sharon and back, made by Mr. Ashburner, and Mr. Carll, in 1877, for the purpose of comparing the conglomerates covering the hilltops in Potter and McKean.**

By CHAS. A. ASHBURNER,
Assistant in charge McKean, Elk, Cameron and Forest
Counties.

The weather was particularly favorable for barometric observations; and the elevations given below were determined by a Hicks aneroid, from Erie railroad grade at Port Allegheny as a datum=1482' above tide.

Between Port Allegheny and Coudersport the levels were corrected by the profile of the Jersey Shore and Pine Creek railway.

Section No. 1.

The following section was made of the hill north of the river in warrant 2174, McKean County, between Coleman and Sartwell creeks :

- 2125 Summit of hill capped by soft greenish-gray flaggy sandstone, book leaf structure.
- 1975 to 1995 probably greenish argillaceous shale. Book-leaf structure.
- 1975 Terrace.
- 1855 Gray and reddish-gray sand flags containing iron specks.
- 1810 Line of springs and swamp grass.
- 1735 Terrace.
- 1535 Red shale, probably bottom of red measures. (Between 1535 and 1735 strata passed over in all probability red shale.)

* These notes are taken from a letter addressed to Prof. Lesley, in December, 1877. More particular and special reference is made to the comparison between the Potter and McKean section in the report (R) on McKean County.

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1510 In a cutting along the roadside the rock consists of 20 feet more or less of a soft greenish-grey and reddish-grey sand shale containing minute plants; underlaid by a hard massive greenish-grey sandstone 4 to 5 feet thick containing concretionary iron balls, scattered plant remains and broken imperfect fragments of fish. The total thickness of rock exposed in the cut is 25 feet.

The summit of the hill is in all probability an ice terrace.

From this point the river was followed to Coudersport without any outcrop of the Roulet conglomerate* being detected, other than a few small sporadic beds of conglomerate in the RR. cut at the mouth of Fishing creek, which are referred to later.

Section No. 2.

At the south end of Coudersport the following section was constructed on the hill above Sherwood's Vespertine (Pocono) sandstone quarry :

2275 Estimated height of summit opposite quarry and S. E. of river. Summit formed by top of the OLEAN CONGLOMERATE.

2075 Summit; terrace above quarry, covered with loose, scattered pieces of a rather massive, fine grained, yellow sandstone containing more or less iron resembles the SUB-OLEAN CONGLOMERATE in eastern McKean.

1990 Scattered fragments of red micaceous sandstone, character typical Catskill.

1960 Very strongly marked red soil.

1940 Red soil and scattered fragments of red shale.

1870 Flaggy greenish-gray sandstone resembling somewhat that at quarry, 5 feet exposed.

1780 Red soil.

1720 Red soil.

1688+ Red drift.

1665 Elevation of bottom of quarry. Three feet carbonaceous S. S. Twenty feet green and gray sandstones somewhat massive and false bedded containing a band 4' thick of green flags, containing mica specks. Three or four feet above the top of the carbonaceous S. S. occurs a sporadic band, 18" thick, of rotten, mottled, calcareous ferruginous clay sand shale. (I should take it that this S. S. would make a rather poor building material. The character of the strata changes very much in a short distance.)

*Roulet conglomerate is a name given to Mr. Sherwood's Chemung conglomerate, supposed by him to be represented by scattered blocks in the vicinity of Roulet.

Section No. 3.

On the hill northeast of the river, half a mile from Coudersport and between that town and Lymanville the following facts were observed :

- 2250 Summit of hill about 800' ± east of the point where the bottom of the conglomerate was located; capped by OLEAN CONGLOMERATE.
- 2200 Base of OLEAN CONGLOMERATE well marked.
- 2130 Terrace (noticed also on hills on west side of river) resembles that made by top of the SUB-OLEAN CONGLOMERATE in McKean Co.
- 1810 Bottom of quarry on east side of river and opposite above; rock exposed of the same character.
Between 1795 and 1685 probably red shale continuously.
- 1795 Quarry on west side of Allegheny river half a mile from town, consisting of greenish gray, flaggy sandstone, containing micaceous specks and exhibiting book-leaf structure.
- 1693 3+ exposed of gray flaggy sandstone.
- 1685 5-6 feet red shale, rather massive, ferruginous and micaceous, readily weathers.
- 1675 Water level at Coudersport tannery.
3 feet gray micaceous flags, breaking into plates 2 to 3 inches thick and from 3 to 6 feet on a side.
- 4 feet rather hard massive green S. S. with a tendency to break up vertically and fracture; the character of the stratum changes very much in a short distance. Same as top stratum of quarry below town.

Section No. 4.

From Coudersport the Allegheny river was followed to the mouth of Steer creek and thence up the creek to the Lamont summit, which is very nearly on the Hebron, Roulet and Bingham anticlinal.

At an elevation of 2080', along the roadside, in warrant 1207 south of Lamont, there is an exposure of five feet of greenish flags resembling somewhat those exposed at the Coudersport quarry, containing a thin layer (3" to 5" thick) of a flat pebble conglomerate, showing broken remains of *fish bones*.

This exposure of five feet is directly overlaid by red shale.

- 2270 Summit at Lamont road forks, red shale. Red soil between this summit and conglomerate band at 2080.

Descending from Lamont summit, we visited Sherwood's outcrop of "*Chemung conglomerate*," one mile southeast

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of East Hebron, near saw mill, and 40 feet above bed of creek.

2020 This exposure consists of a stratum of fine-grained yellowish sandstone, 4" to 6" thick, overlaid by a dark red slaty argillaceous shale, 3'± thick. No conglomerate was observed, and it seems that the mass exposed *may be in place or it may not*.

From East Hebron a northwesterly course was taken, crossing through the Oswayo synclinal, by Clara and thence to Sharon Centre.

Section No. 5.

At Newton & Bigby's saw mill, on the Oswayo creek, half a mile west of Sharon Centre, the following section was observed in the hillside, where a cutting had been made for the dam :

1525 Surface of dam.

25 feet soft fragile dark olive shale, very much stained with iron containing at irregular intervals bands a few inches thick of more massive strata. Shale has a tendency to weather into horizontal fingers 4 to 8 inches long, fine-grained.

5 feet dark brownish red shale, highly ferriferous and slightly micaceous, containing fossil shell of Chemung type.

3+ Bluish gray shale.

1492 Water level, below dam.

There are several pools around the saw mill strongly impregnated with iron, evidently derived from red shale. The iron scum has been mistaken for petroleum.

Returning from Sharon Centre, we passed through Clara again, and crossed the Oswayo mountains to Hebron, at the head waters of Fishing creek.

Section No. 6.

From Sharon Centre to Clara the township road, for most of the distance, passes over red shale. There is an exposure of gray flags overlaid by red shale at an elevation of 1695, at the turn of the road, as it begins to ascend the Oswayo mountains. In the ascent the last red soil seen was at an elevation of 1960 feet. According to Sherwood's map this would be very near the Oswayo synclinal. The first summit

in the road is 2320 feet, and the summit of Hebron hill, above the quarry spoken of below, is 2360 feet.

Just below the summit of the hill, and a short distance N. E. of the road, as it begins to descend into the valley of Fishing creek, there is a quarry, the elevation of the bottom of which is 2280 feet. The rock exposed is a hard, rather massive, greenish gray, flaggy sandstone, containing white and micaceous specks, particularly the latter, exhibits false bedding in a marked degree, and is very much broken up on the outcrop. There is 8 feet of rock exposed, and it is overlaid by red shale soil.

There is no sandstone or conglomerate seen from the road, on the hilltop or slopes immediately below, and the general character of the topography resembles very much that formed by the SUB-OLEAN measures in McKean. If the hill be capped by the SUB-OLEAN rock, there must be a band of red shale* between it and the rock exposed at the quarry, (2280) (which resembles the typical Pocono.) In northern McKean I have never found any red shale *directly under the SUB-OLEAN*.

2250 Pieces of the "Chemung conglomerate" are found on the hill slopes 200 feet above the road forks at Hebron and at an elevation of 2250 and in "large angular blocks" around Hebron. This conglomerate which Mr. Sherwood calls Chemung, and which occurs along Fishing creek at Hebron and in the adjoining township of Clara, resembles very much in lithological character the SUB-OLEAN in McKean County. From the position of the scattered masses at Hebron, I think it more than probable that they have descended from the stratum which may form the top of the Oswayo mountains at the road crossing.

Descending Fishing creek no exposure was observed; in Clara township, mixed up with the conglomerate blocks seen at Hebron, there are blocks of another conglomerate resembling somewhat that seen below the red shale at Lamont. It is more than probable that these scattered pieces may come from thin sporadic conglomerate bands occurring in the strata outcropping in the hill slopes along Fishing creek.

* This red shale is no doubt the representative of the Mauch Chunk red shale No. XI. I have found it in south-eastern McKean County, near Keating, and generally throughout Elk and Cameron Counties.

On the south side of the Allegheny river just below the mouth of Fishing creek, there is a RR. cut, in soft greenish-gray shaly sandstone, containing irregular scattered bands of conglomerate, a few inches thick. A number of fragments of *fish remains* were found in some of the strata; Mr. Sherwood refers this exposure to the Chemung. I consider the rock equivalent to that at the foot of Pulpit hill. See sections 1, 6, and 7 of the plate illustrating this chapter.

Conclusions.

From a comparison of the accompanying sections, I have come to the following conclusions:

First. The strata from 1975 to 1995 of the Pulpit hill section, No. 1, is the same as the strata at 1870 of the Coudersport No. 2; distance between sections $3\frac{1}{2}$ miles. The sandstone exposed at the bottom of the cut at Pulpit hill is at least 265 feet below the bottom of the Coudersport quarry.

Second. The cut at the foot of Pulpit hill is in the same strata as are exposed in the RR. cut at the *mouth of Fishing creek*. The dip between Pulpit hill and Fishing creek, would be about $35 \pm$ feet to the N. W. making the dip from Roulet to the center of the basin at Coudersport $110 + 35 = 145$ feet.

If the dip of the strata from Roulet, which is on the center of the anticlinal to the center of the basin at Coudersport, is only 145 feet, and in view of the general parallelism of the anticlinal and synclinal, it would be hardly probable, or even possible, for the strata to dip more than 200 feet from Lamont to Coudersport.

This conclusion seems to be sustained by the general evenness of the tops of the hills. If the *fish bed conglomerate* on Lamont hill was the same as the *fish bed conglomerates* at the mouth of Fishing creek, and at the foot of Pulpit hill, it would necessitate a dip of 750 feet from Lamont to Coudersport; such a dip is hardly possible, if our comparison of the Pulpit hill and Coudersport sections be correct.

On the assumption of a dip of 200 feet between these two places the *fish bed conglomerate* which is exposed directly under the red shale at Lamont, at an elevation of 2080 feet,

would occur in the Coudersport section at an elevation of 1880 feet or 215 feet above the Coudersport quarry, and the sandstone stratum one mile S. E. of East Hebron which Mr. Sherwood considers the representative of the Chemung conglomerate would occur 165 feet more or less above the Coudersport quarry, which he considers the representative of the Pocono sandstone (Vespertine No. X,); or in other words, the exposure of his *typical Chemung conglomerate* would be above the exposure of his *typical Pocono*.

It must be remembered in comparing the sections, that they are in some places colored from the soil, which only indicates in a very general way the character of the underlying strata. In fact, it is necessary to exercise extreme caution in basing conclusions on the soil. To the southeast of Lamont summit everything is red; to the northwest of Lamont nothing is red.

According to this reasoning the place of the bottom of the OLEAN CONGLOMERATE above the Lamont summit would be really 2400 feet, and the terrace which is found at Coudersport at an elevation of 2130' and which may indicate the top of the SUB-OLEAN CONGLOMERATE would have occurred over Lamont summit at an elevation of 2330.

Third. The elevation of the summit of the Oswayo mountains, over the Oswayo synclinal axis, is 2360 feet; and assuming that this is formed by the top of the representative of the SUB-OLEAN, the dip from Lamont (on the anticlinal) to Hebron Hill (in the synclinal) would be (2360—2230) 130 feet. The dip from Roulet on the Roulet anticlinal to Pulpit Hill, about half way between the Roulet anticlinal and the Oswayo synclinal, was only 35 feet. This shows a sharpening of the synclinal to the N. E. which is also indicated by Mr. Sherwood's location of the axes on the map. Pieces of what Sherwood calls *Chemung conglomerate* at Hebron were found on the hill slopes only 160 feet below the summit of Hebron hill. Judging from the size and weathered character of these loose pieces of conglomerate they must have come from a stratum topographical much higher, unless they have been carried over the Oswayo mountains by glaciers. To my mind there is no question but that they

have fallen from a stratum which at present forms the Oswayo summit or what at one time formed a slightly higher summit which has been eroded. I have come to the conclusion that the conglomerate at Hebron cannot be the remains of the *Chemung conglomerate* as described by Mr. Sherwood and that the Hebron hill is not capped by Pottsville conglomerate if the conglomerate capping the hills at Coudersport be called Pottsville. Aside from my own observations and reasoning from Mr. Sherwood's facts I do not see how the pieces of conglomerate scattered at Hebron can be his Chemung conglomerate nor how Hebron hill can be capped by Pottsville conglomerate. The red Catskill and gray Pocono would have to be on that supposition crowded into an interval of 100 feet.

The lowest stratigraphical exposure visited was at Newton & Bigby's saw-mill $\frac{1}{2}$ mile west of Sharon Centre. The rock exposed in this hill side is probably 100 feet more or less below the gray flags, at an elevation of 1695 feet in the Hebron section.

The highest stratigraphical stratum observed was the OLEAN CONGLOMERATE on the summit of the Coudersport hills.

On the hill slope around Sharon Centre, and say 100 feet above the village numerous scattered pieces of a *flat pebble conglomerate* are found. It seems probable that they come from thin bands occupying the same geologic position as the bands of conglomerate seen in the RR. cut at the mouth of Fishing creek.

Section No. 7.

The following is a general compiled section of the formations found in Roulet, Eulalia, Clara, Hebron, and Sharon townships, Potter county :

| | |
|--|-----|
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| | |
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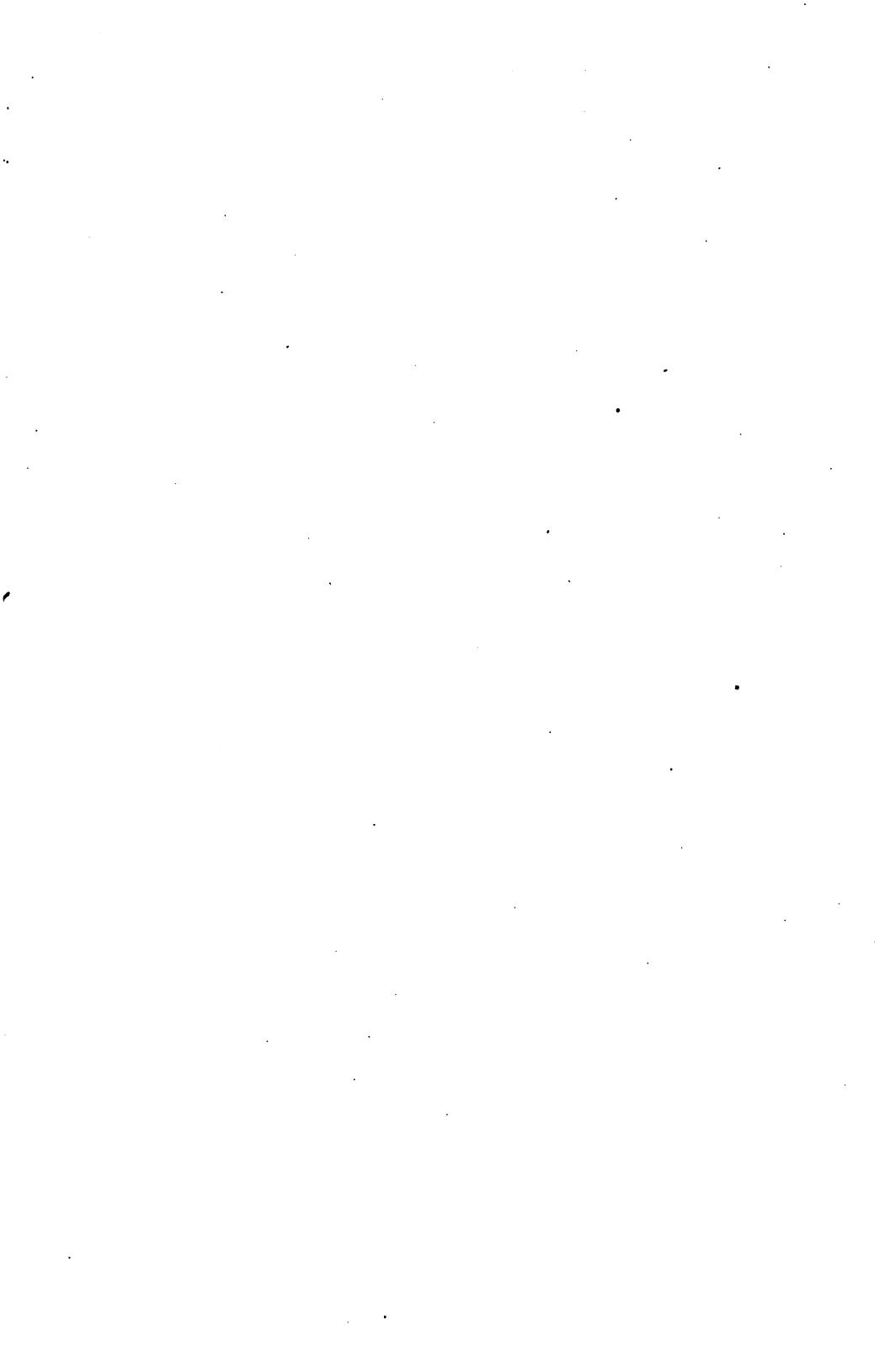
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